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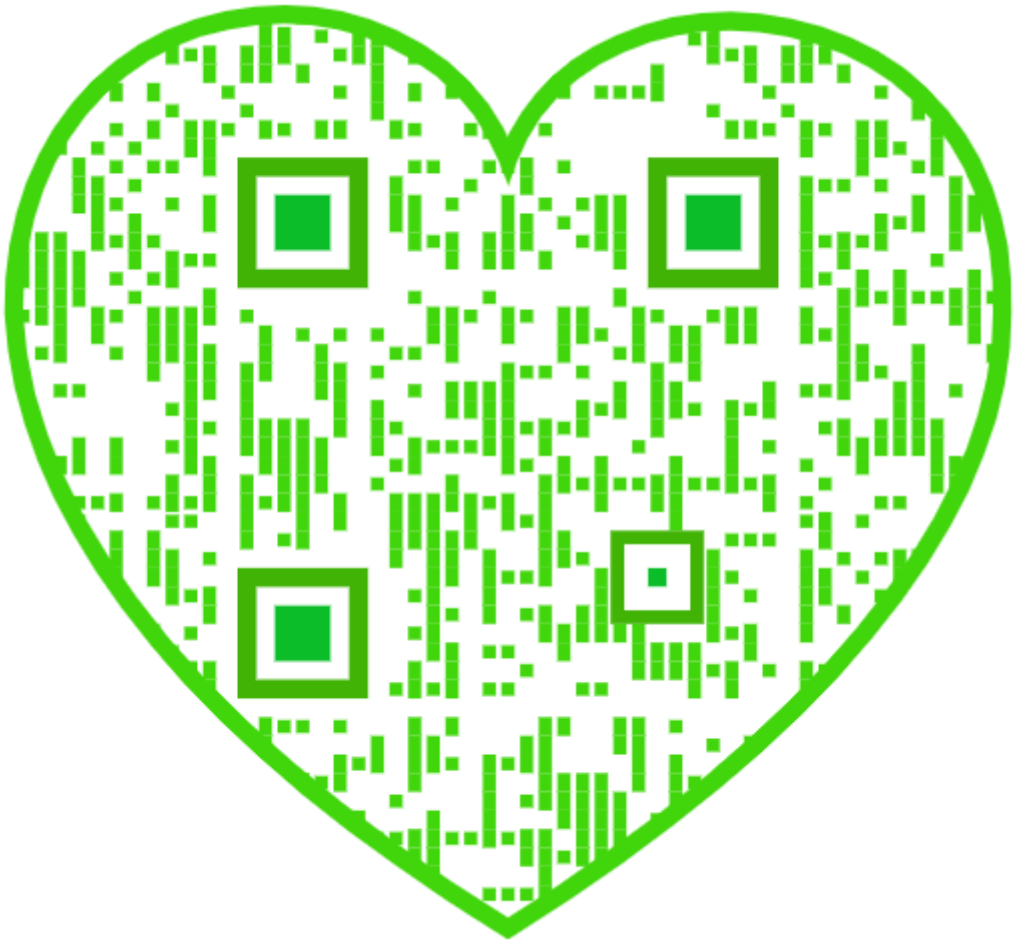

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A TEXT-BOOK OF OBSTETRICS

BY BARTON COOKE HIRST, M.D.

PROFESSOR OF OBSTETRICS IN THE UNIVERSITY OF PENNSYLVANIA;
GYNECOLOGIST TO THE HOWARD, THE ORTHOPÆDIC, AND
THE PHILADELPHIA HOSPITALS, ETC.

Sixth Edition, Revised and Enlarged
with
847 Illustrations, 43 of them in Colors

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PHILADELPHIA

TO

RICHARD A. F. PENROSE, M.D., LL.D.

EMERITUS PROFESSOR OF OBSTETRICS AND OF THE DISEASES OF WOMEN AND CHILDREN IN THE UNIVERSITY OF PENNSYLVANIA

This Book is Gratefully Dedicated

BY HIS FORMER PUPIL, THE AUTHOR

157245

PREFACE TO THE SIXTH EDITION.

The revision for the sixth edition has been thorough. The most extensive additions have been made in the section on operations, which now includes the operations for the complications and consequences of the child-bearing process at all periods—that is to say, all the gynecologic operations. Many works on obstetrics are curiously deficient in this respect. Pan-hysterectomy for chorio-epithelioma is as much an obstetric operation as the application of forceps. It is illogic to recommend the operative treatment for retroversion of the uterus following childbirth; salpingo-oöphorectomy for ectopic pregnancy and the infections of the puerperium; supravaginal hysterectomy for fibromyoma or for the Porro-Cesarean section; the plastic operations for injuries of the genital canal, and then to tell students nothing about the kind of operation to select or the technic of its performance. An effort has also been made to present a brief account of the diagnosis and treatment of all the pathologic phenomena peculiar to women, which is the proper scope of a work on obstetrics.

All the diseases of women must be considered in relation with the chief act in woman's history, child-bearing. The vast majority of them are consequences of that process. All of them are possible complications. Consequently, the specialist in this branch of medicine must be an expert in every department of gynecology. In fact, he is the only specialist qualified as an expert by command of clinical material, by extent and variety of experience. It is not surprising, therefore, that the bulk of this work is coming into his hands in America as all of it long ago came into the hands of his colleagues in the older medical centers of the world. To maintain his reputation, retain his practice, and escape legal responsibility the general physician also must be prepared at

least to make diagnoses and to give proper advice on all the complications and consequences of child-bearing, and on the relations between the diseases of women and that process.

A number of new illustrations have been introduced; some of the older ones have been discarded. The literature has been carefully reviewed. Whatever study or personal experience has demonstrated to be an advance of real value has been introduced into the text.

1821 Spruce Street, Philadelphia.
June, 1909.

PREFACE.

This work is the result of a practice devoted for the past twelve years exclusively to gynecology in both its branches—obstetrics and gynecic surgery. The author has served during this period as consulting and attendant gynecologist and obstetrician in eight of the principal hospitals of Philadelphia. His experience in obstetrical complications and operations has consequently been exceptionally large. He has been engaged, moreover, during the whole of his professional career, in teaching medical students in clinics, hospitals, laboratories, and in the lecture-room. He ventures to entertain the hope, therefore, that his training has fitted him for the preparation of a book which shall serve as a guide to undergraduate students and to physicians in active practice. It has been his constant aim to condense the text as far as is consistent with a comprehensive treatment of the subject. Illustrations have been extensively employed, the majority of them from original photographs and drawings. The task, impossible within a single volume, of presenting a complete bibliography of each subject has not been attempted. The student who desires such information is referred to the "Catalogue of the Surgeon-General's Library," the ten volumes of the "Jahresbericht über die Fortschritte auf dem Gebiete der Geburtshilfe und der Gynäkologie," and to the "Index Medicus." References are given to articles and books which have been most helpful to the author or which have been epoch-making in the history of obstetrics.

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A TEXT-BOOK

OF

OBSTETRICS.

Introduction.

"Obstetrics," derived from a Latin word meaning to stand in front of, as a midwife stood or knelt before her patient on the birth stool, originally signified the assistance afforded a woman in labor. Its modern significance is wider. It includes a study of the physiology and pathology of conception, gestation, parturition, and the puerperium, with all the complications and pathologic consequences of the child-bearing act at all periods. It embraces, therefore, a study of all the diseases peculiar to women.

PART I.

PREGNANCY.

CHAPTER I.

Anatomy of the Pelvis; Development and Anatomy of the Female Generative Organs.

THE ANATOMY OF THE PELVIS.

The hip-bones together with the sacrum, including the coccyx, compose the pelvis, which forms the basin-like lower portion of the trunk. In the erect position of the body the pelvis is bent obliquely backward from the vertebral column above, so that the crest of the pubis descends nearly to a level with the end of the sacrum. The pelvis is divided into two parts by a prominent rim, named the brim of the pelvis, which is formed on each side by the iliopectineal line continued behind the crest of the pubis and by the curved ridge and promontory of the sacrum. The upper part is formed by the ilia, and includes the widest space of the pelvis which pertains to the abdominal cavity. The lower part is distinguished as the true pelvis, and incloses the cavity of the pelvis. It is a complete bony girdle, formed by the sacrum and coccyx, the ischium and pubis, and a small portion of the ilium. The upper extremity

of the pelvic cavity, corresponding with the brim, is the inlet, or superior strait; the lower extremity is the outlet, or inferior strait. In consequence of the curvature of the sacrum and coccyx the pelvic cavity appears as a curved cylinder, slightly narrowed toward the outlet. It is deepest behind and shallowest at the pubic symphysis. Its lateral wall is deep and vertical. It extends from the iliopectineal line to the end of the ischial tuberosity, and is mainly formed by the body of the ischium with small portions of the ilium and pubis. The anterior depth of the pelvis (height of the symphysis) is 4 cm. (1.57 in.). The lateral depth is 9 cm. (3.54 in.). The posterior depth is 13 cm. (5.12 in.).

The pelvic inlet is cordiform, with the notched base conforming with the base of the sacrum and the rounded apex with the pubes. The outlet, rather smaller than the inlet, when completed by the great sacrosciatic ligaments has the same shape, with the notched base formed by the coccyx and the apex

Fig. 1.—Female pelvis (one-third natural size) (Dickinson).

by the pubic symphysis. Its fore part is the pubic arch, the base of which extends between the ischial tuberosities; and the sides are formed by the conjoined rami of the pubes and ischia. On each side of the outlet is the deep sacrosciatic notch, formed in front by the ischium, above by the ilium, and behind by the sacrum and coccyx. It is converted into the great and small sciatic foramina by the sacrosciatic ligaments, which also separate them from the pelvic outlet. The pelvis of the female not only differs from that of the male in accordance with the usual

difference in other parts of the skeleton, but also exhibits important modifications which relate to the sexual function. The female pelvis is proportionately larger, but of more delicate construction. It is proportionately, and often absolutely, of greater breadth, and is of less depth. The ilia spread more laterally, so as to produce greater breadth or prominence of the hips than in the male. The true pelvis has greater horizontal capacity, less depth, and is commonly less curved and less contracted at the outlet. The inlet is larger, less intruded upon by the sacral promontory, and is more circular or transversely oval. The outlet is likewise larger, with the ischial tuberosities less convergent, and with the pubic arch wider, lower, more truly arched, and with the sides more everted.

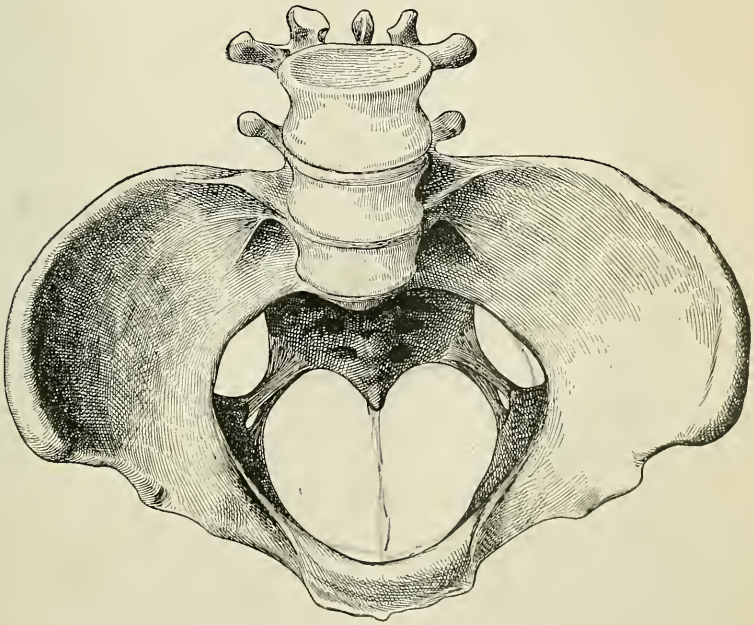


Fig. 2.—The funnel-shaped false pelvis.

In the female the sides of the pubic arch are narrower, more flattened, and less ridged than in the male.[1]

The hip or innominate bones—in the adult a single piece—are composed, in fetal life and in childhood, of three separate bones,—the ilium, the ischium, and the pubis. The three bones are united by a triradiate cartilage in the acetabulum, which begins to ossify at puberty, the ankylosis being complete in the

[1] This brief anatomical description of the pelvis is taken, modified, from Leidy's "Anatomy."

eighteenth year. The descending ramus of the pubis and the ramus of the ischium are also originally united by a cartilage which ossifies at about the eighth year.

The bony pelvic girdle in the adult is united by three joints, the symphysis pubis and the two sacro-iliac joints. The former is a synchondrosis; the junction of the pubic bones by the intervening cartilage is strengthened by ligaments above, before, behind, and below the symphysis. The last named is the strongest. It is the arcuate ligament of the pubis. The pubic junction will withstand a weight of 197 kg. before rupturing (Selheim). The sacro-iliac joints are true joints (amphiarthroses), with all their characteristic features. The joint surface of the sacrum is broader behind and above than it is before and below, so that the sacrum cannot be pushed forward or downward without separating the innominate bones. The joints are reinforced by comparatively weak ligaments anteriorly, but by strong ligaments posteriorly, the best developed of which are the sacro-iliac ligaments. The sacro-iliac joints withstand a pressure of 160 to 310 kg.

The Anatomy of the Pelvis Obstetrically Considered.—To the obstetrician the pelvis is a canal and not a basin, and is to be studied mainly in its relation to the fetal body which must pass through it. The false pelvis is of minor importance, acting simply as a funnel-shaped structure to direct the presenting part toward and into the superior strait of the true pelvis. The obstetrical study of pelvic anatomy may be confined to the shape, size, position, and direction of the true pelvis.

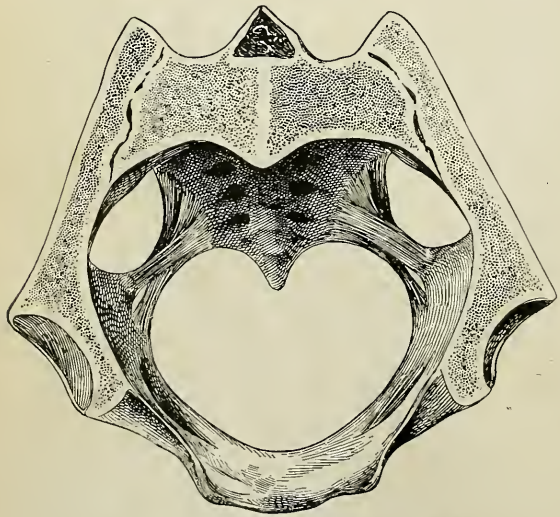


Fig. 3.—The shape of the superior strait.

Pelvic Shape.—The pelvis might be described as a truncated cylinder, but the description would not be exactly accurate. As a matter of fact, the pelvic canal is of different shapes at different levels, and it is necessary to study certain typical planes of the pelvis

in order to understand fully the relationship of fetal to pelvic shape in labor. The first of these imaginary planes is laid at the entrance to the pelvic cavity or canal, the pelvic inlet or superior strait, and is bounded by the promontory of the sacrum, the iliopectineal lines, the crests of the pubis, and the upper edge of the symphysis. The shape of the pelvic inlet is cordiform. In the bays on either side of the promontory rest the important nerve-trunks and blood-vessels of the pelvis, where they are guarded from the pressure of the fetal head. It was thought formerly that the shape of the pelvic inlet was elliptical, but this is only exceptionally the case, as in certain justominor pelves, in which the nerve-trunks and vessels may be subjected to such excessive pressure that disease and disability result.

In studying the pelvic canal from above downward it appears that the canal expands below the pelvic inlet and then contracts again as it approaches the outlet. It is convenient, therefore, to lay off a plane at the level of greatest expansion and another at the level of greatest contraction, which are called, respectively, the plane of pelvic expansion and the plane of pelvic contraction. The shape of the pelvic canal at the plane of pelvic expansion, passing through the middle of the sym-

Fig. 4.—The diameters of the superior strait.

physis, the top of the acetabula, and the sacrum, between the second and third vertebræ, is almost exactly circular, being only

a trifle larger in its anteroposterior than in its transverse diameter. The shape of the pelvic canal at the plane of pelvic contraction, passing through the tip of the sacrum, the spines of the ischia, and the lower surface of the symphysis, is distinctly elliptical, being a centimeter longer anteroposteriorly than it is transversely.

Finally, the shape of the pelvic outlet, or inferior strait, is cordiform, from the projection forward of the tip of the sacrum and the coccyx.

Pelvic Size.—In determining the size of an irregularly shaped canal like that of the pelvis it is necessary again to resort to certain typical planes at different levels, and to measure typical diameters in these planes. Beginning with the cordiform pelvic inlet it is obvious that its dimensions may best be expressed by the following diameters: *An anteroposterior diameter* measured from the middle of the promontory of the sacrum to the symphysis pubis, about 3.17 mm. (⅛ in.) below its upper edge; this measurement averages, in the well-developed Caucasian woman, 11 cm. (4.33 in.).

A transverse diameter, the longest distance from side to side of the pelvic inlet, measuring on the average 13.5 cm. (5.32 in.), and two *oblique diameters*, the right from the top of the right, the left from the top of the left sacro-iliac junction to the opposite ilio-pectineal eminences, measuring 12.75 cm. (5.02 in.). At the plane of pelvic expansion it is possible to measure but two diameters, an anteroposterior and a transverse; the former is 12.75 cm. (5.02 in.), the latter, 12.5 cm. (4.92 in.).

At the plane of pelvic contraction the anteroposterior diameter is 11.5 cm. (4.43 in.), the transverse, 10.5 cm. (4.13 in.). At the inferior strait the anteroposterior diameter, measured from the tip of the coccyx to the lower edge of the symphysis pubis, is 9.5 cm. (3.74 in.); but this is not a fixed measurement, as the coccyx is normally movable and is displaced backward in labor; the obstetrical anteroposterior diameter, therefore, is measured from the tip of the sacrum to the lower edge of the symphysis pubis; it is 11 cm. (4.33 in.). The transverse diameter, measured from one to the other tuberosity of the ischium, is 11 cm. (4.33 in.).

Pelvic Position.—By pelvic position is meant the angle or inclination of the pelvis to the trunk and to the horizon. The inclination of the plane of the superior strait to the horizon, as the individual stands erect, is fifty-five degrees, and of the inferior strait, ten degrees. The inclination of the pelvis, however, changes with changes of posture. It disappears in a squatting or sitting posture, and is increased if the individual leans backward. The greater the inclination of the pelvis, the more the axis of the superior strait diverges from the long axis of the uterine cavity, and con-

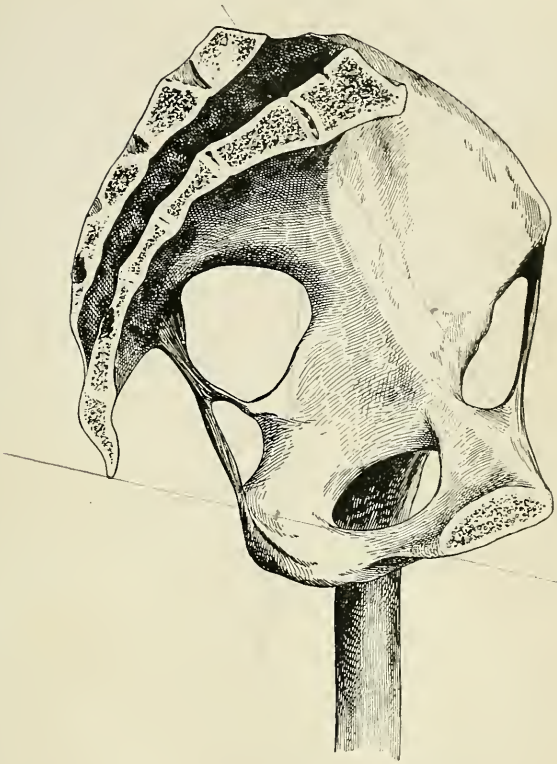


Fig. 5.—The inclination of the pelvis.

sequently the greater must be the divergence in direction of the presenting part from that of the rest of the fetal body when the former engages in the superior strait. Much stress was once laid upon this fact, but, by placing a woman upon her side and flexing the thighs upon the trunk, the inclination of the pelvis

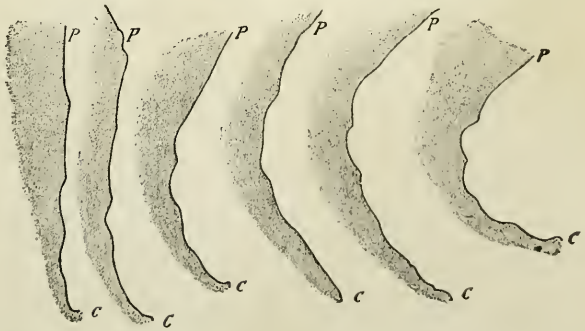


Fig. 6.—Variation in sacral curves: *P*, Promontory of sacrum; *C*, coccyx. (Tracings of sacra in the author's possession.)

is made practically to disappear. The obliquity of the pelvis, therefore, need not be seriously considered, as a rule, in labor, but the habitual inclination of the pelvis as the woman stands erect must be taken into account in a study of the pelvic deformities of rachitis, lordosis, kyphosis, spondylolisthesis, and osteomalacia; some of the anomalies of labor in these pelvic deformities; and the abnormal relations of the external genitalia to the pelvis, whenever the latter shows an excessive or deficient inclination.

Pelvic Direction.—By this term is meant the direction of the central axis of the pelvic canal. It was the custom in a former generation to express pelvic direction by a complicated mathematical formula, yielding what was called the "curve of Carus." Not only is this formula unnecessarily complicated, but it is also incorrect. The direction of the pelvic canal depends entirely upon the curve of the sacrum, which varies greatly. Taking, at random, any half-dozen or so of sacra from a collection, the utmost diversity of curvature is seen. The direction of the pelvis may be described with approximate accuracy as a line parallel with the sacral curve, and equally distant at all points from the pelvic walls.

The Development of the Pelvis.—It may be easier to understand the peculiarities of the adult pelvis if one considers the forces imposed upon it and their influence upon the individual bones and upon the pelvis as a whole. The pelvis is subjected to the weight of the trunk imposed upon it from above, the counter-pressure of the limbs below, and the pull of powerful ligaments, muscles, and joints. The weight of the trunk, transmitted from above downward and from behind forward, tilts the pelvis forward by a rotary movement on its transverse axis and confers upon it the characteristic position or inclination. This force, however, is resisted by the pull of the muscular and ligamentous connections between the trochanters of the femora and the tuberosities of the ischia and by the pressure of the heads of the femora on the acetabula. By the former force the tuberosities of the ischia are pulled apart and the normal width of the pelvic outlet is secured. The sacrum bears the greatest weight of the trunk, and in consequence its top is forced downward and forward. It is also pulled forward and downward, even in fetal life, by the extension of the thighs. The natural consequence would be to tilt the lower end of the sacrum and the coccyx backward, but they are subjected to the powerful pull forward of the ligaments and muscles attached to them and to the lateral and anterior pelvic walls. Hence the sacrum, subjected to these two opposing forces, is bent like a bow between them, and thus acquires its perpendicular curve. As the upper portion of the sacrum moves

downward and forward, it drags with it the posterior superior portions of the iliac bones, to which it is attached by the sacro-iliac junctions and by the strong sacro-iliac ligaments. The natural result of the movement of the posterior portions of the innominate bones inward, downward, and forward would be to throw outward the anterior extremities of these bones, were they not joined firmly at the symphysis. Subjected to the force behind and restrained by their junction in front, the innominate bones are bent upon themselves, and thus acquire their lateral curve.

These few illustrations by no means exhaust the dynamics of the pelvis. The subject will be referred to again in the study of some of the pelvic deformities.

The Bony Pelvis in Life Filled with Soft Tissues.—Besides the generative organs, the obstetrical anatomy of the pelvis must

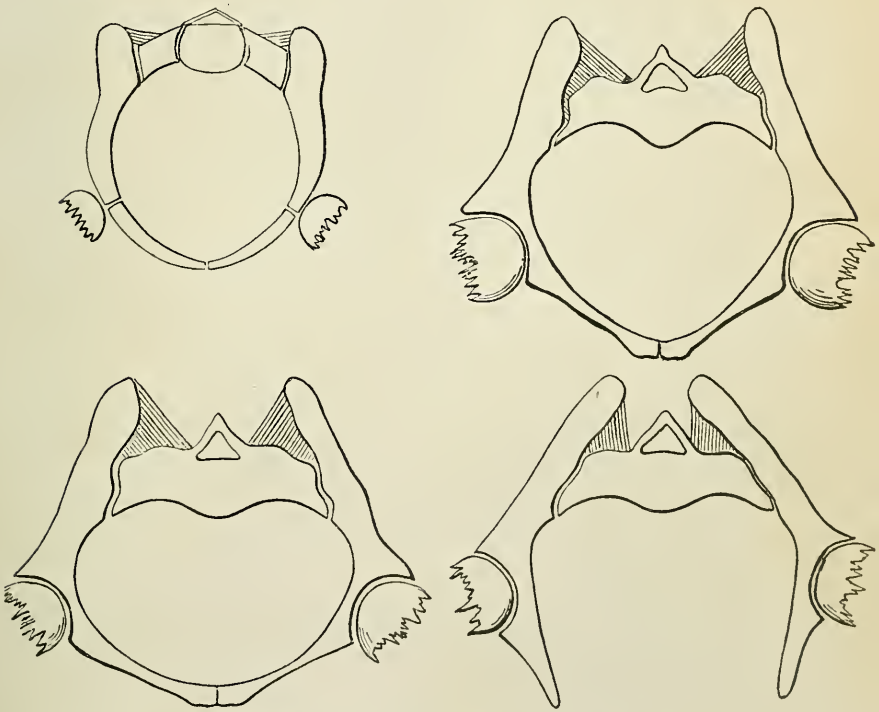


Fig. 7.—The pull of the ligaments and the pressure of the femora upon the pelvis (Schroeder).

take into account the muscles, ligaments, connective tissue, blood-vessels, lymphatics, and nerves.

The Muscles.—The iliopsoas, the obturator internus, and the pyriformis clothe the pelvic walls, modifying the diameters of the pelvic cavity and acting as buffers or cushions to protect the child's body in its passage through the birth-canal. The bulky iliopsoas muscles diminish the transverse diameter of the pelvic inlet by 5 cm. (2 in.), thus making the oblique diameters of the pelvic inlet the longest and insuring ordinarily an oblique position of the presenting part, but these muscles are subject to compression and to some displacement under pressure in labor, and, if the pressure is great, the transverse diameter again becomes the longest; hence the transverse position of the head in obstructed labors. The coccygeus, the levator ani, the retractor ani, the sphincter ani, the constrictor vaginæ, and the transversus perinei are the muscles of the pelvic floor giving the direction to

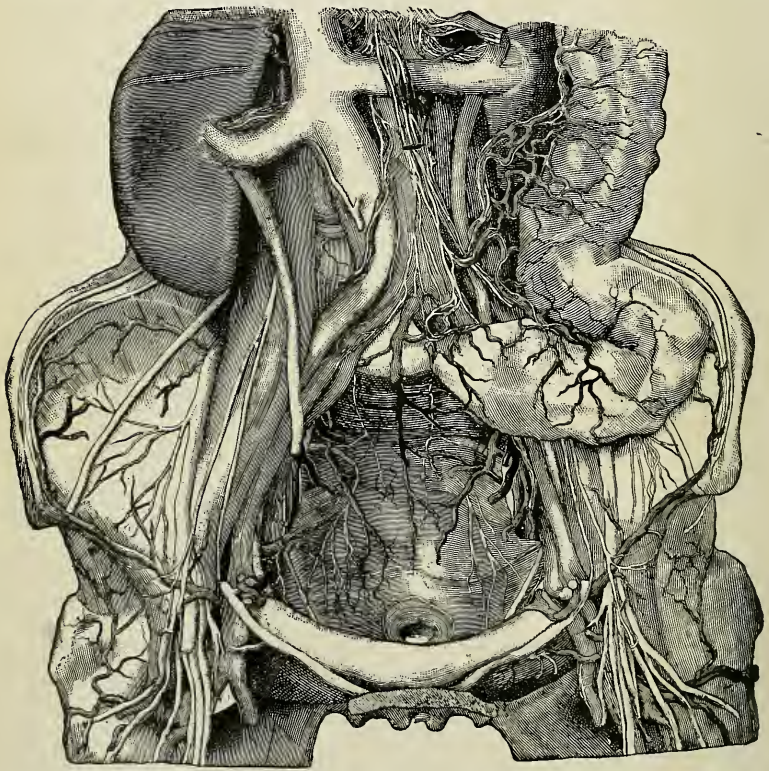
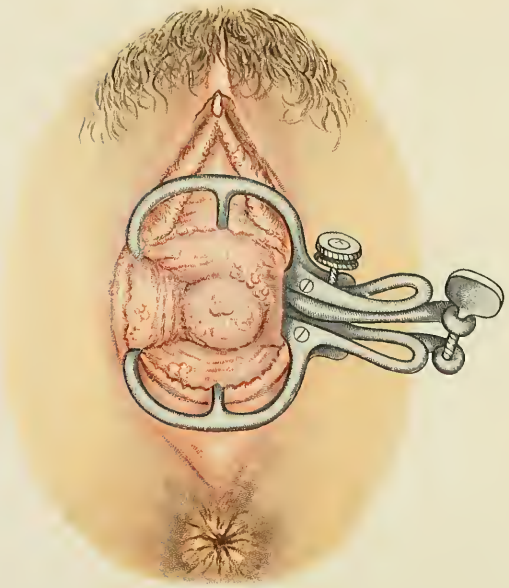


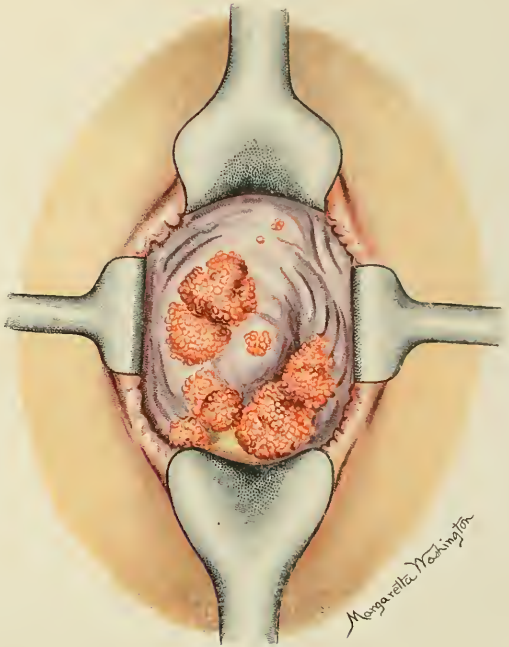
Fig. 8.—The pelvis with its soft parts (bladder, rectum, uterus and its appendages, having been removed) (from a model in the University of Pennsylvania).

the lower part of the parturient tract in labor and directing the presenting part forward, outward, and upward under the pubic arch. The levator ani is by far the most important muscle in the

PLATE 9.



Granular vaginitis in pregnancy.



Venereal warts growing from the vaginal vault and cervix in a woman eight months pregnant.

pelvic floor. It is a strong, horseshoe-shaped band of muscle, consisting of two symmetrical halves slung back from the anterior pelvic wall and surrounding the vagina and rectum. It is the chief factor in pushing the presenting part forward away from the perineum and out through the vulvar orifice. It is thus the chief conservator of the integrity of the pelvic floor in labor. Its injury robs the rectum and posterior vaginal wall of their strongest support, allowing them to drop downward, outward, and forward in the rectocele, with which the surgeon has to deal in secondary operations upon so-called lacerations of the perineum.

Fig. 9.—The pelvic canal encroached upon by the soft structures (Veit).

The ligamentous structures of the pelvis of greatest interest to the obstetrician are the obturator membranes and the sacrosciatic ligaments, which close the pelvic walls, help to impart to the canal its shape and direction, and, by their situation at either end

of the oblique diameters, receive upon their yielding surfaces the greatest pressure from the extremities of the long diameters of the fetal head,—an arrangement much more favorable for the child than would be the compression of the longest diameters of the head between bony pelvic walls.

The Connective Tissue of the Pelvis.—An intimate knowledge of the complex arrangement of the pelvic fascia is not essential

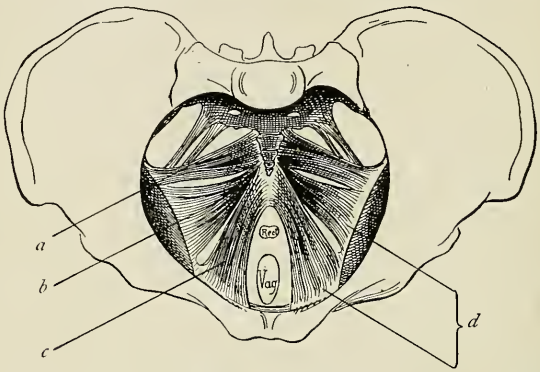


Fig. 10.—The pelvic diaphragm from above: *a*, Ischio-coccygeus muscle; *b*, iliac portion of the levator ani; *c*, pubic portion of the levator ani; *d*, arcus tendineus (Bumm).

to the obstetrician. For his purpose it suffices to remember that the arrangement of the pelvic connective tissue may be compared, roughly speaking, to a six-pointed star centering at the uterus, the three arms on each side being disposed as follows: A lateral

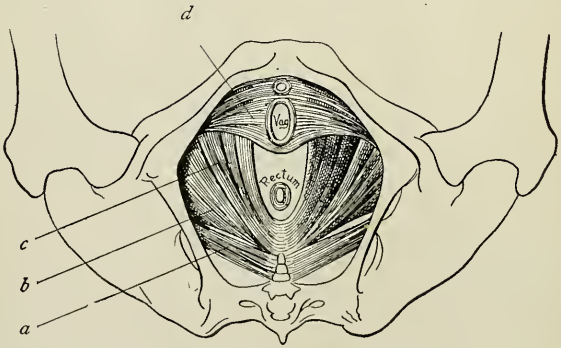


Fig. 11.—The pelvic diaphragm, seen from below: *a*, Ischio-coccygeus; *b*, iliac portion of levator ani; *c*, pubic portion of levator ani; *d*, urogenital diaphragm, including muscle of the urogenital trigonum (Bumm).

arm running out from the uterus between the layers of the broad ligament and becoming continuous with the subperitoneal connect-

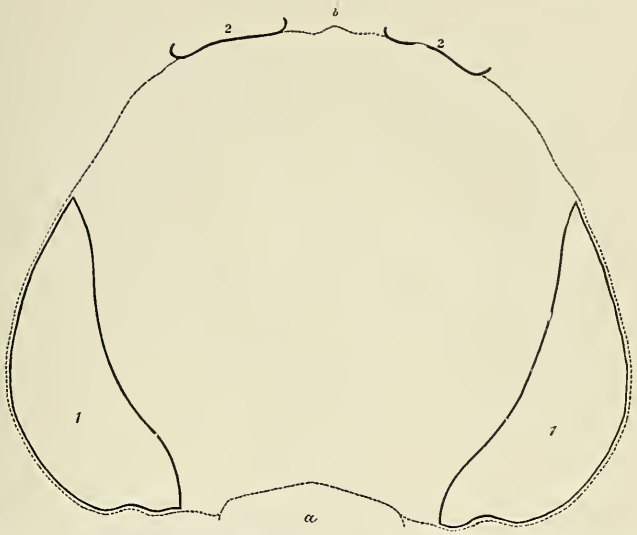


Fig. 12.—Schematic representation of the superior strait: *a*, Promontory; *b*, symphysis; 1, 1, iliopsoas muscles; 2, 2, rectus abdominis; dotted line, the pelvic inlet (Veit).

ive tissue of the lateral pelvic wall; an anterior arm skirting the bladder; a posterior arm skirting the rectum and continuing in

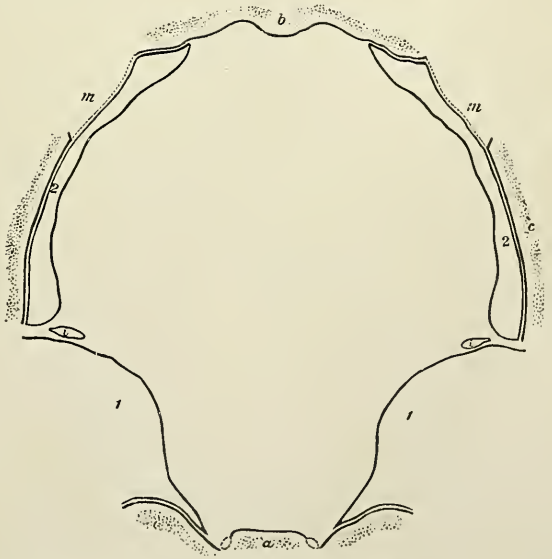


Fig. 13.—The plane of pelvic expansion: *a*, Sacrum; *b*, pubis; *c*, lateral pelvic wall; 1, 1, pyriformis; 2, 2, obturator internus; *m*, *m*, obturator membrane; *i*, *i*, sciatic nerve.

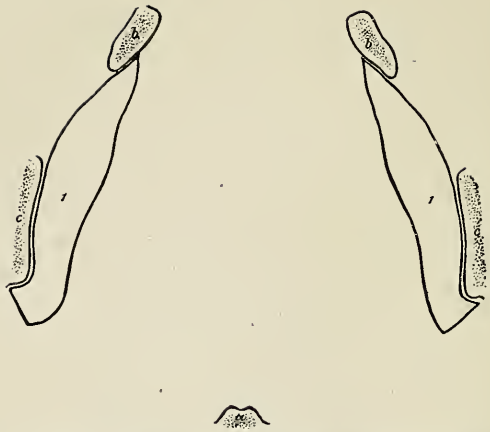


Fig. 14.—Plane of pelvic contraction: *a*, Tip of sacrum; *b*, *b*, ascending ramus of pubis; *c*, *c*, ischium; 1, 1, obturator internus.

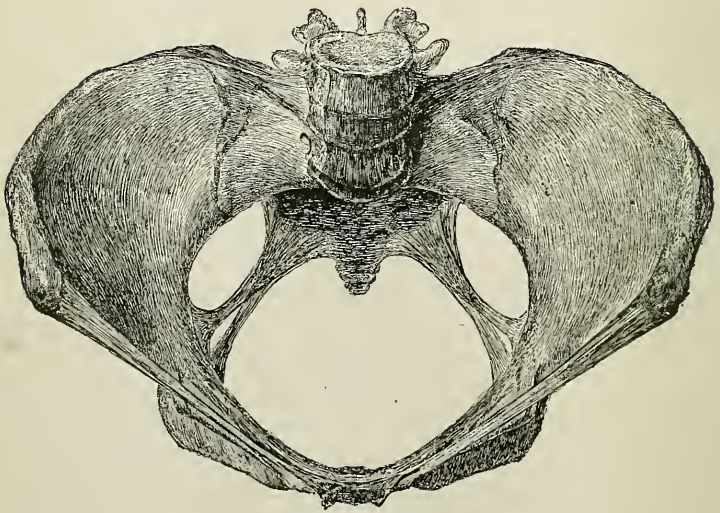


Fig. 15.—Female pelvis, viewed from above, with ligaments (one-third natural size) (Dickinson).

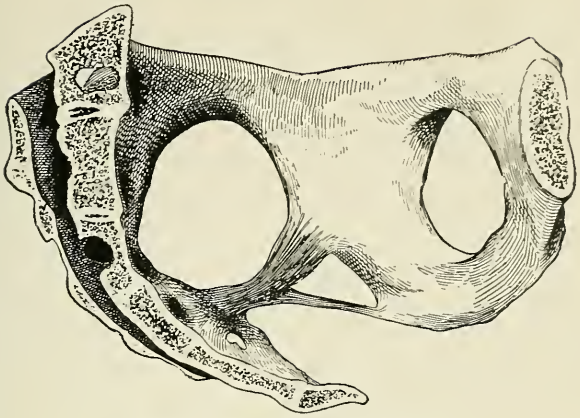


Fig. 16.—Sacrosciatic ligaments.

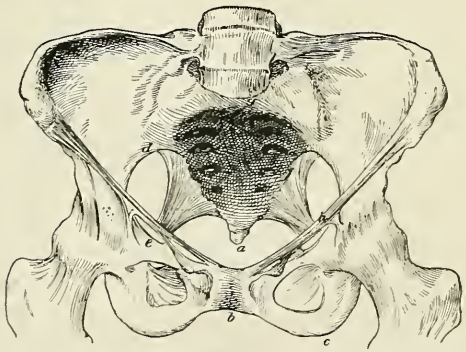


Fig. 17.—The pelvic ligaments from above: *a*, Tip of sacrum; *b*, subpubic ligament; *c*, tuber ischii; *d*, sacrosciatic notch; *e*, aperture for femoral vessels and nerves; *h*, Poupart's ligament (Hart).

Fig. 18.—The pelvic ligaments from below. Lettering same as above, except *x*, sacrosciatic foramen.

the mesorectum to the posterior pelvic wall. Branching processes, in addition, follow the round ligament to the groin and mons veneris, the vessels and nerves escaping through the sacrosciatic notch to the buttocks, the three canals of the pelvis—the urethra, vagina, and rectum—to the subcutaneous connective tissue of the external genitalia and perineum.

The Blood-vessels.—The ovarian arteries, leaving the aorta, enter the pelvis on their respective sides and, passing between the laminæ of the broad ligament a short distance under its upper edge, send branches to the ovaries and tubes and a branch to the fundus, while the main trunk turns at a right angle downward alongside the uterus, to anastomose with the uterine artery, giving off on its way numerous branches to the uterine wall. The uterine artery on both sides passes downward from the anterior trunk of the internal iliac to the neck of the uterus, giving off a large branch to the lower uterine segment and cervix, the circular artery of the cervix, and numerous smaller branches to the uterine wall as it rises to meet the ovarian artery. The veins of the pelvic organs of chief interest to the obstetrician are the large trunks between the layers of the broad ligament alongside the uterus and the complicated pampiniform plexuses in the neighborhood of the ovaries.

The lymphatic ducts of the pelvic organs are of interest mainly in the part they play in the absorption of the involuting uterus and by conveying septic micro-organisms and the products of their activity into the system. The lymph-spaces of the uterus, lying between connective-tissue bundles and clothed with endothelial cells, empty by means of ducts into the pelvic system of lymphatic glands. The most important groups of the pelvic lymphatic glands are the uterine, obturator, hypogastric, lumbar, sacral, and inguinal. It is interesting to note that the lymphatic ducts of the lower fourth of the vagina terminate in the inguinal glands. The enlargement, inflammation, and suppuration of the inguinal glands, therefore, indicate infection of the parturient outlet.

The nerves of the generative organs are derived from the spinal and the sympathetic systems. The sexual processes, however, of ovulation and of menstruation and the action of the uterine muscle in labor are controlled by the sympathetic nerves, derived mainly from the hypogastric and ovarian plexuses. The clinical observation that paralysis of the spinal nerves supplying the pelvic organs in nowise interferes with gestation and labor, and the experiments on bitches of resecting the lumbar cord and seeing the animals exhibit rut, become gravid, and bear pups, show what a subordinate part the spinal nerves play in the sexual processes of the female.

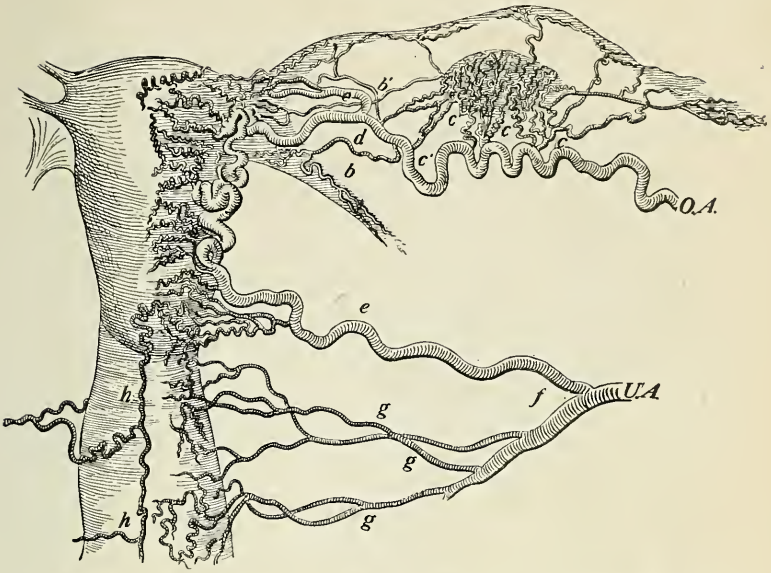


Fig. 19.—The arteries of the uterus and ovaries: *O.A.*, Ovarian artery; *b*, artery of the round ligament; *b'*, branch to the tube; *c*, *c*, *c*, branches to the ovary; *d*, continuation of main trunk; *e*, branch to the cornu; *U.A.*, uterine artery; *e*, main trunk; *f*, bifurcation; *g*, vaginal branches; *h*, vaginal branch from the cervical artery (Hyrtl).

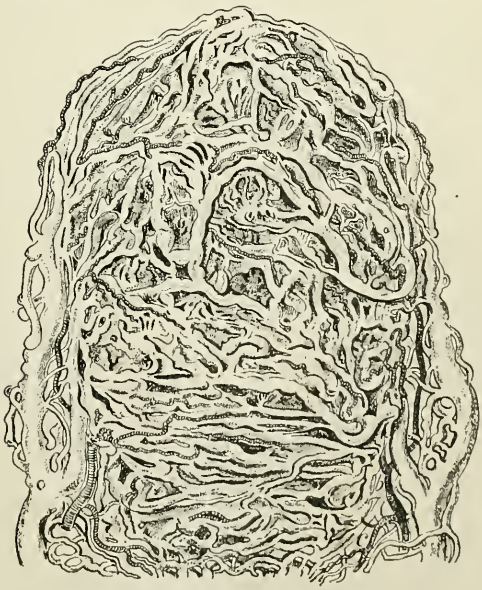


Fig. 20.—The veins of the uterus (Hyrtl).

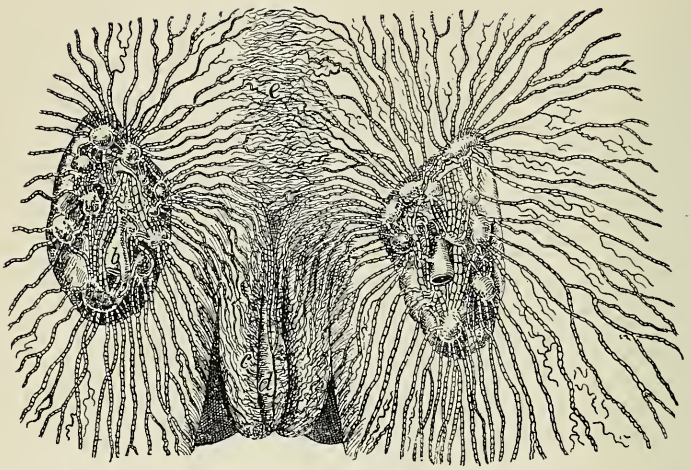


Fig. 21.—Distribution of lymphatics, externally: *b*, Inguinal glands; *c*, *d*, ducts of the labia; *e*, lymphatics of the mons veneris (Sappey).

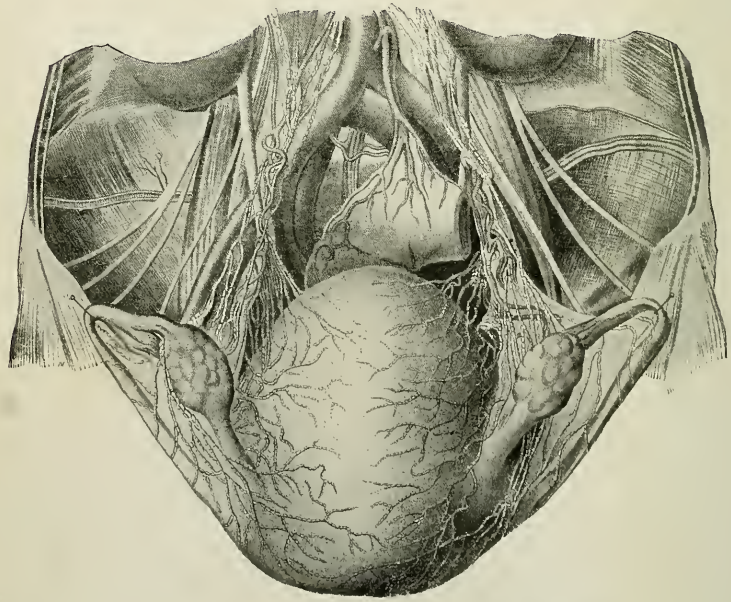


Fig. 22.—The lymphatic ducts of the uterus and its appendages injected, in a woman who died shortly after delivery.

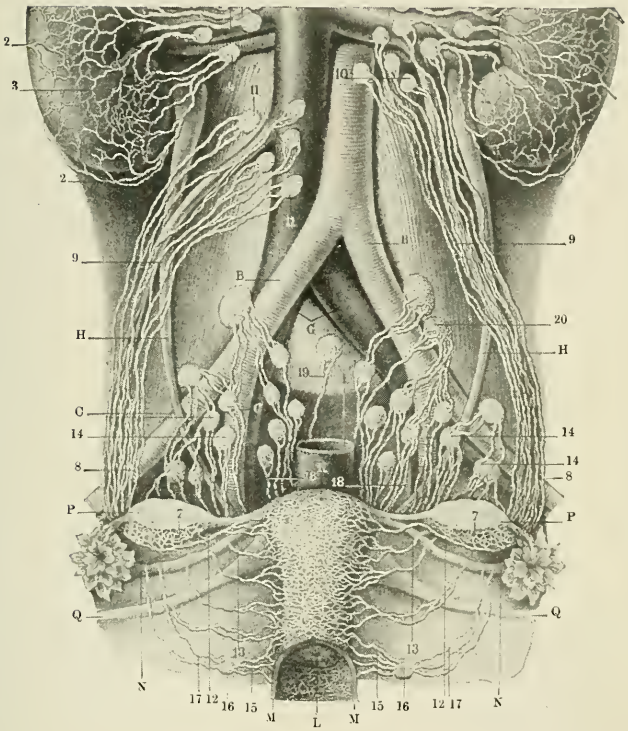


Fig. 23.—Lymphatics of the pelvic viscera and abdomen: A, Aorta; B, B, iliac arteries; C, C, the bifurcation and two branches of the iliac arteries; D, vena cava; E, left renal vein; F, right renal vein; G, iliac veins; H, H, ureters; I, rectum; K, uterus; L, cervix; M, M, vaginal walls; N, N, Fallopian tubes; P, P, ovaries; Q, Q, round ligaments; 1, Deep lymphatic vessels of the right kidney, and ganglia into which they empty; 2, 2, 2, 2, superficial lymphatic vessels; 3, 3, 3, 3, the same; 4, two ganglia that receive these superficial vessels; 7, 7, subovarian plexus of lymphatics; 8, 8, ducts leading from this plexus; 9, 9, the same; 10, 10, 11, 11, glands receiving these ducts; 12, 12, 12, 12, lymphatic ducts, originating in the fundus uteri, and terminating in the same glands as the ovarian ducts; 13, 13, ducts from the anterior surface and sides of the uterus; 14, 14, glands into which they empty; 15, 15, ducts originating in cervix and upper part of vagina; 16, 16, glands into which they empty; 17, 17, efferent vessels of these glands; 18, 18, lymphatic ducts from posterior surface of the uterus and glands into which they empty; 19, lumbar gland (exceptional); 20, gland into which occasionally a duct from lower uterine segment empties (Sappey).

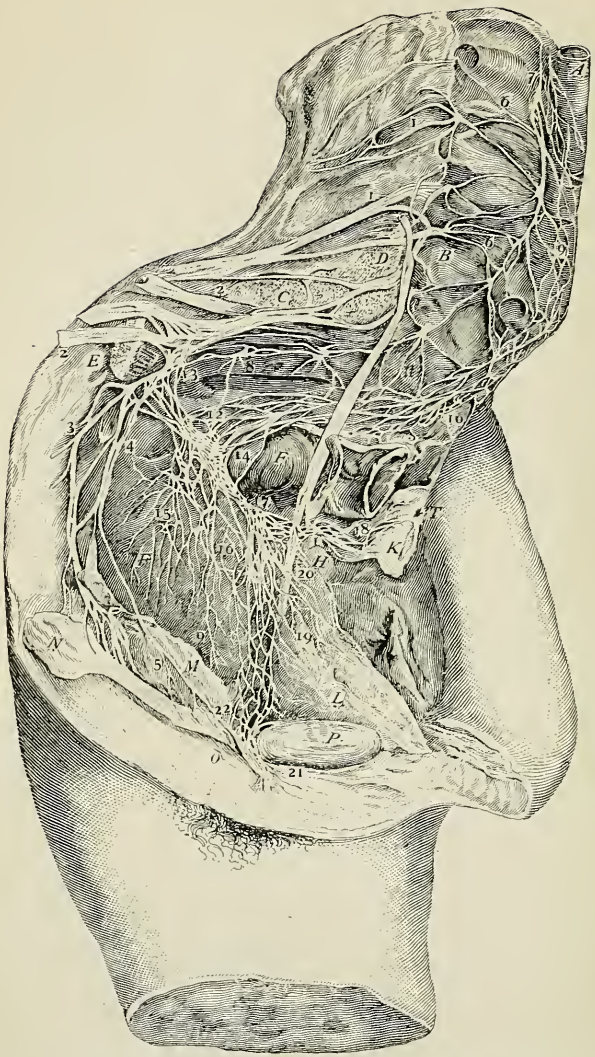


Fig. 24.—The nerves of the pelvis: *A*, Abdominal aorta; *B*, lumbar vertebræ with intervertebral discs; *C*, the right portion of the sacrum sawn after removal of os innominatum; *D*, ureter; *E*, pyriformis muscle cut at its exit from the pelvic cavity; *F*, the curve of the rectum, corresponding to the anterior surface of the sacrum; *H*, virginal uterus feebly developed; *K*, right ovary displaced somewhat upward; *L*, bladder; *M*, levator ani muscle, cut in part; *N*, ischiocavernosus muscle; *O*, corpus cavernosum clitoridis, joining on the other side the clitoris, covered with nerve-filaments; *P*, symphysis pubis (the whole body being inclined forward, it has become horizontal); *T*, fimbriated end of Fallopian tube; 1, 1, *Lumbar nerves*, passing out of the intervertebral foramina to form the *lumbar plexus;* the lower lumbar and the upper sacral nerves joining to form the *sacral plexus* in front of the pyriformis muscle; 2, sacral plexus; 3, *gluteal nerves* cut; the *pudic nerve* springing by several roots from the plexus

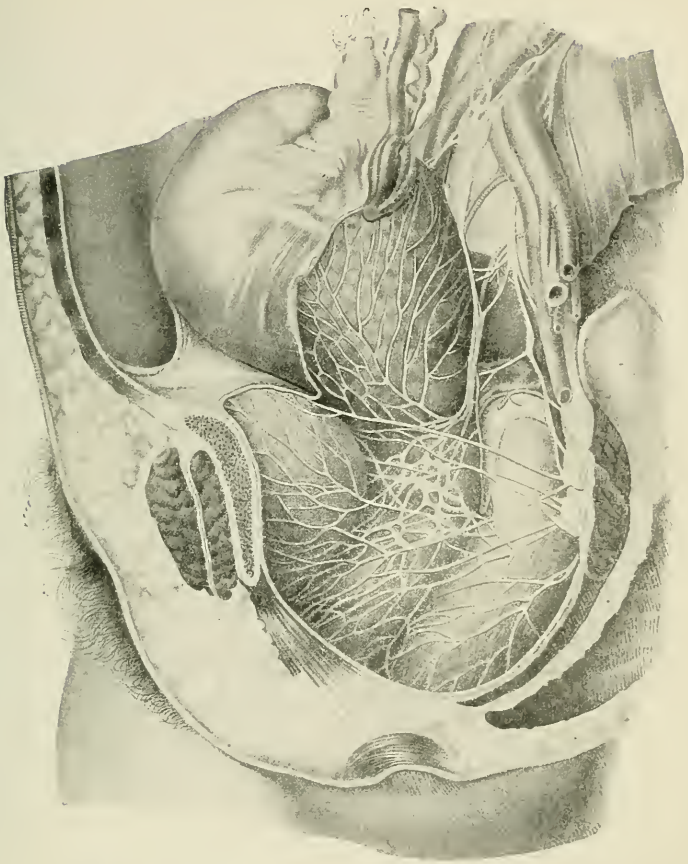


Fig. 25.—Pelvic nerves of a puerpera four days postpartum.

formed by the lower sacral nerves; 5, fine twigs passing from the pudic nerve to the ischiocavernosus muscle; the main trunk goes under the symphysis, and ends as the *dorsal nerve of the clitoris* (21); 6, 6, branches of communication which carry sympathetic twigs to the spinal nerves and spinal twigs to the hypogastric plexus of the sympathetic; 7, principal trunk of the *sympathetic* in front of the lumbar vertebræ; 8, continuation of the sympathetic in front of the sacrum; 9, 9, *aortic plexus:* 10, *hemorrhoidal plexus*, following the arteries of the same name; 11, *superior hypogastric plexus*, or *iliohypogastric plexus*, which receives many spinal and sympathetic branches; 12, *inferior hypogastric plexus*, communicating with 13, *anterior sacral plexus*, made up of spinal and sympathetic branches; 14, from the many ganglia placed in this plexus it has a network appearance; 15, inferior rectal twigs, which pass down even to the sphincter, where they form a network covered by the levator ani; 16, *vaginal plexus;* 17, that part of the inferior hypogastric plexus in the shape of a fine network at the upper end of the vagina gives branches to the bladder, the Fallopian tube, and the clitoris; 18, nerve twigs which run on the side wall of the uterus, giving branches to it, upward to the Fallopian tube and ovary, where they join the nerves following the ovarian artery, which correspond to the spermatic plexus in man; 19, vesical nerves; 20, *uterine plexus;* 21, *dorsal nerve of clitoris*, which joins with the *cavernous plexus of the clitoris* from the sympathetic to the glans clitoridis (Rydygier).

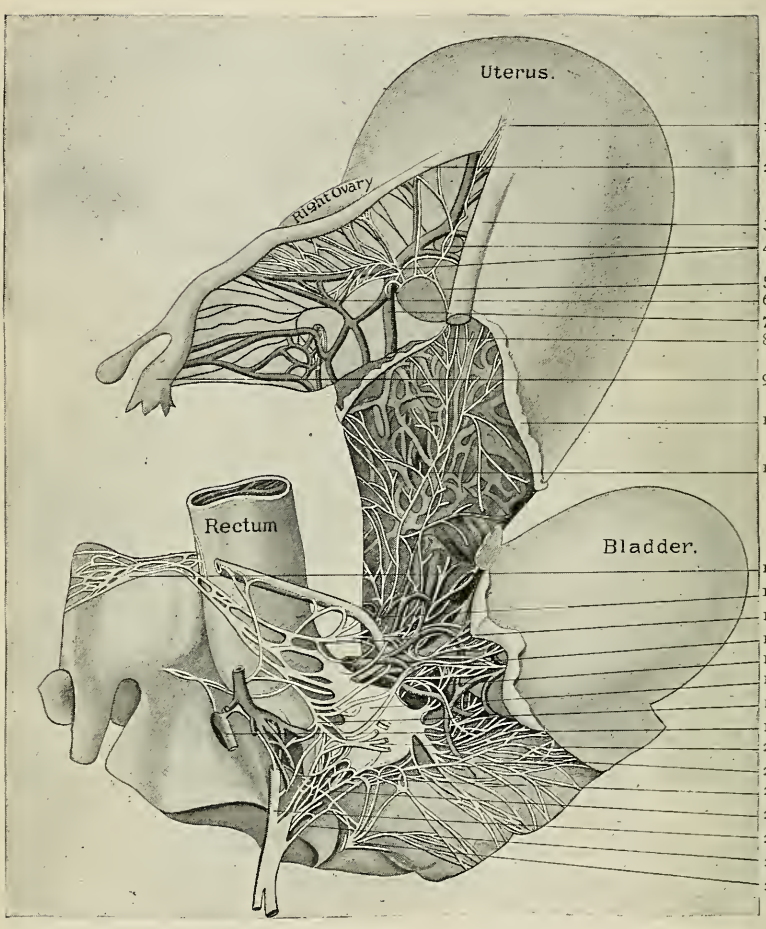


Fig. 26.—Nerves of the pelvic organs of the female: 1, Nerves to fundus of uterus; 2, right Fallopian tube; 3, right round ligament; 4, nerves to Fallopian tube; 5, communication between ovarian and uterine nerves; 6, ovarian plexus of veins; 7, ovarian vein; 8, nerve passing to join ovarian plexus; 9, fimbriated extremity of Fallopian tube; 10, reflected peritoneum; 11, uterine nerves; 12, superior hypogastric plexus; 13, branches from hypogastric plexus to uterus; 14, inferior hypogastric plexus; 15, vesical nerves; 16, communicating branches to vesical plexus; 17, cervical ganglion; 18, branches of hypogastric plexus to cervical ganglion; 19, first sacral nerve; 20, branches passing to bladder; 21, branches passing between bladder and rectum; 22, communicating branches from second sacral to cervical ganglion; 23, branch from third sacral nerve to cervical ganglion; 24, second sacral nerve; 25, branches from third sacral nerve to vagina and bladder; 26, branches passing from fourth sacral to cervical ganglion (Frankenhäusen).

THE FEMALE SEXUAL ORGANS.

The development of the sexual organs may be briefly described as follows :

The development of the genito-urinary organs up to a certain point is common in both sexes. In late stages the duct of Wolff almost disappears in the female, while in the male it constitutes the vas deferens ; the Müllerian ducts, on the contrary, atrophy in the male, but form Fallopian tubes, uterus, and vagina in the female.

The accompanying illustrations (Figs. 27, 28, 29, and 30) may aid the student to understand the subdivision of the primary cloacal chamber. As they refer to the female embryo, the Wolffian ducts are omitted.

Fig. 27. Fig. 28. Fig. 29. Fig. 30.

Fig. 27.—*cl*, Cloaca which has opened into primitive hind-gut, and communicates with the rectum and allantois; the posterior portion, *all*, of the latter has commenced to dilate to form the urinary bladder; *m*, duct of Müller; *r*, rectum.

Fig. 28.—The cloaca has divided into a ventral portion, *su*, the urogenital sinus, which communicates ventrally with the urethra, *u*, and the bladder, *b*, and more dorsally with *v*, the vagina, formed by fusion of the ducts of Müller; *r*, rectum.

Fig. 29.—The perineum or tissues separating the rectum from the urogenital sinus are well developed; the neck of the bladder has become constricted to form the primitive urethra, and is separated from the vaginal passage, though both open into the common urogenital sinus, *s*, and the clitoris, *c* (in the male the rudiment of the penis), has appeared; *r*, rectum.

Fig. 30.—The urogenital sinus of the female, *s*, remains as the cleft between the sides of the external aperture of the labia minora; it communicates in front with the bladder, *b*, and dorsally with the vagina, *v*; *r*, rectum.

The essential sexual glands develop in both sexes in close association with the ducts of Wolff and Müller, and in the neighborhood of the mesonephros. The cells lining the abdominal region of the primitive celom early become differentiated as its lining epithelium; in most regions they quickly become flat scales, but over the bulging of the intermediate cell-mass they enlarge and become columnar in form. These enlarged cells remain for some time over all of the projecting surface of the intermediate cell-mass, and even extend beyond it upon the outer side of the developing mesentery. They soon become flattened over most of the mass, but remain columnar and multiply for some time on its inner and outer sides. On the latter they give

origin to the Müllerian duct and some segmental tubes and soon cease to be distinct; on the former they constitute the primitive germinal epithelium. The mesoblast lying beneath this epithelium gives rise to the blood-vessels and connective tissue (stroma) of the ovary or testis, as the case may be. At this stage it is difficult or impossible to detect the sex of the embryo from the structure of the sexual glands.

In the female some cells of the germinal epithelium enlarge to form the primitive ova. Surrounded by other cells from the germinal epithelium, they grow into the ovarian stroma as the egg-tubes or cords and give rise to the primitive Graafian follicles.

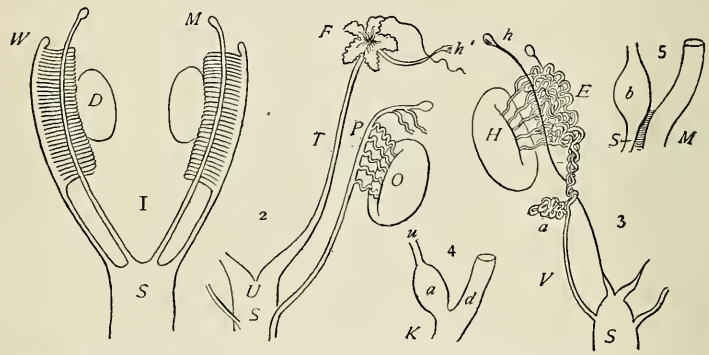


Fig. 31.—Diagrams to illustrate the development of the internal genital organs in both sexes. I, Hermaphrodite or undifferentiated condition: *d*, Ovary or testis, lying upon the tubules of the Wolffian body; *W*, Wolffian duct; *M*, duct of Müller; *S*, urogenital sinus. 2, Modifications in the female: *T*, Primitive Müllerian duct, forming the Fallopian tube and developing fimbriæ, *F*, around its peritoneal opening; *h'*, ovarian hydatid; *U*, uterus formed by fusion of the posterior ends of the ducts of Müller; *S*, urogenital sinus; *O* (answering to *D* in I), ovary; *P*, parovarium, or remnant of Wolffian body and duct. 3, Modifications in the male: *H*, Testis (corresponding to *D* in I); *E*, epididymis; *h*, hydatid of Morgagni; *a*, vas aberrans; *V*, vas deferens, or Wolffian duct; *u*, uterus masculinus, the remnant of the lower ends of the fused ducts of Müller; *S*, urogenital sinus (from Landois and Stirling).

The testicle is distinguishable from the fetal ovary about the eighth week. The cells which in the female form ova, in the male subdivide and give origin to the spermatozoa, while the cells which correspond to the lining cells of the female egg-tubes develop the lining cells of the seminiferous tubules. These canals may be detected in the human embryo of ten weeks; they branch, and during the third month are collected into groups, indicating the lobular subdivision of the adult testis.

The genital cord is a cylindrical mass in which, in both sexes, the ducts of Müller and Wolff become imbedded near the urogenital sinus. The four ducts (two from each side) are at first

separate. The Müllerian ducts coalesce at their lower ends and in the female enlarge to form the vagina and the posterior portion of the uterus; in the male the lower fused portions of Müllerian ducts remain as the prostatic vesicle, or uterus masculinus.

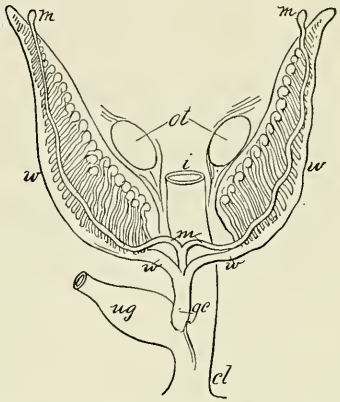


Fig. 32.—Diagrammatic outline of the Wolffian bodies and their relation to the ducts of Müller and the reproductive glands: *ot*, Seat of origin of ovary or testes; *w*, Wolffian body; *w*, Wolffian duct; *m*, *m*, duct of Müller; *gc*, genital cord; *ug*, urogenital sinus; *i*, rectum; *cl*, cloaca (from Allen Thompson).

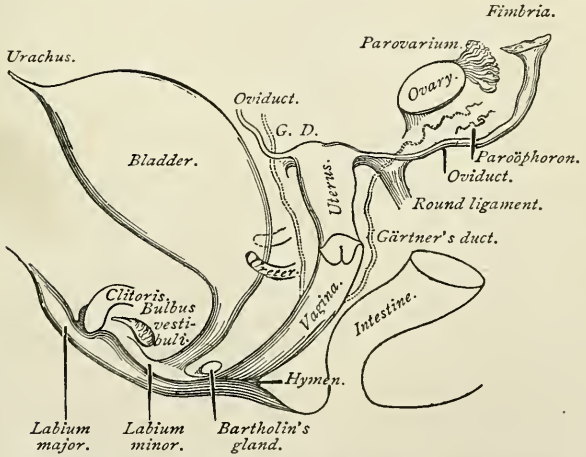


Fig. 33.—Diagram illustrating changes taking place in development of female generative organs (modified from Allen Thompson).

In the female the anterior portions of the ducts of Müller form the upper part of the body of the womb and the Fallopian tubes. In the female the Wolffian ducts almost entirely disappear, but traces of them may be found as the canals of Gärtner.

Pathological development and distention of these ducts sometimes give rise to vaginal cysts, which may obstruct labor.

Meanwhile most of the Wolffian body (mesonephros) disappears on each side, but remnants of it may be found in adults. In the female they constitute the parovarium (epoöphoron, or body of Rosenmüller).

The Development of the External Genitals.—The formation of the cloaca is common to both sexes, as is also its separation into an anal and a urogenital portion. The urogenital sinus is at first narrow and deep, but soon becomes shallow, and meanwhile the perineal tissues separate it more and more from the anus. Before the subdivision of the cloaca a genital eminence appears at its ventral or anterior end about the sixth week. On each side of the cloacal slit outgrowths of skin and

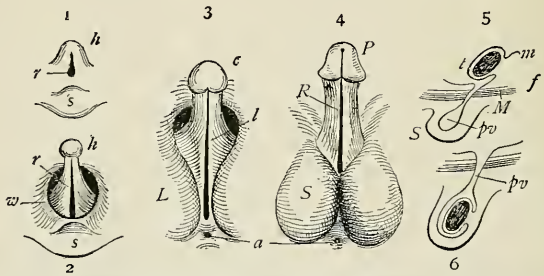


Fig. 34.—To illustrate the development of the human external genitals: 1. *h*, Genital eminence; *r*, cloacal aperture; *s*, tail or coccyx of embryo. 2. *h*, Genital eminence; *r*, cloacal opening; *w*, commencement of labia majora or scrotum, according to sex; *s*, embryonic tail. 3. Next stage, practically permanent in the female; *c*, Genital eminence (clitoris); *l*, nymphæ; *L*, labia majora; *a*, anus. 4. Later or male condition: *P*, Penis; *R*, edges of embryonic folds enfolding to inclose the penial urethra; *S*, scrotum; *a*, anus. 5 and 6 illustrate the descent of the testicle (from Landois and Stirling).

subcutaneous tissue (Fig. 34, 1) become prominent. At the eighth or ninth week there is a groove in the under (posterior) side of the genital eminence, with well-marked side-walls leading back to open into the cloaca. The development of the perineum divides this groove (during the third month) transversely into a smaller anal opening and a larger urogenital. This condition is but slightly modified in the female. The genital eminence in that sex remains small and constitutes the clitoris. The side walls remain separate and form the labia minora, while the cutaneous folds enlarge and become the labia majora (Fig. 34, 3). The urogenital sinus is, therefore, permanent in woman, and forms the vestibule, which has in front of it the clitoris, and, opening

into it, the urethra and vagina. The skinfolds remain separate in the female to form the labia majora.[1]

The genital organs and structures of woman are divided into the external and the internal genitalia. The former, described often as the genitalia, pudendum, or vulva, comprise the mons veneris, the labia majora, the labia minora, the vestibule, with

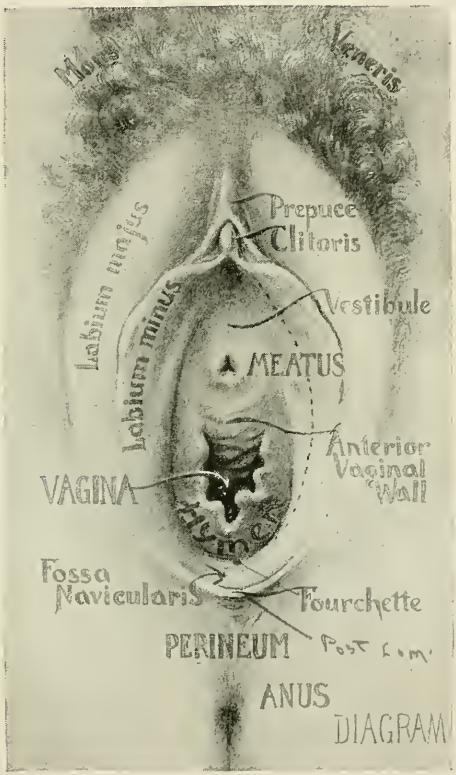


Fig. 35.—Diagram of the genitalia (Dickinson).

the urethral orifice, and the clitoris; the latter, the hymen, the vagina, the uterus, the Fallopian tubes, and the ovaries.

The Mons Veneris and the Labia Majora.—The mons veneris is a flat protuberance over the symphysis pubis, consisting of fat and connective tissue covered with a tough skin clothed with coarse hair. In females the upper border of the hairy region

[1] The description of the development of the sexual organs is taken, with modifications, from Newell Martin's article in "The American System of Obstetrics," edited by the author.

is a horizontal line; in males the hair rises in a triangular shape to a point upon the median line of the abdominal wall. The labia majora are folds of skin containing fat, connective tissue, and involuntary muscle-fibers, continuous with the mons veneris and uniting below an inch in front of the anus. They surround the urogenital fissure. Their points of junction above and below are called the anterior and posterior commissures. Just within the latter there is a crescentic transverse fold of skin, called the fourchet. The region between the fourchet and the posterior commissure is the fossa navicularis.

The Labia Minora, or Nymphæ.—Just below the anterior commissure of the labia majora the nymphæ begin on each side as two leaflets of delicate skin; one, the upper, with its fellow of the other

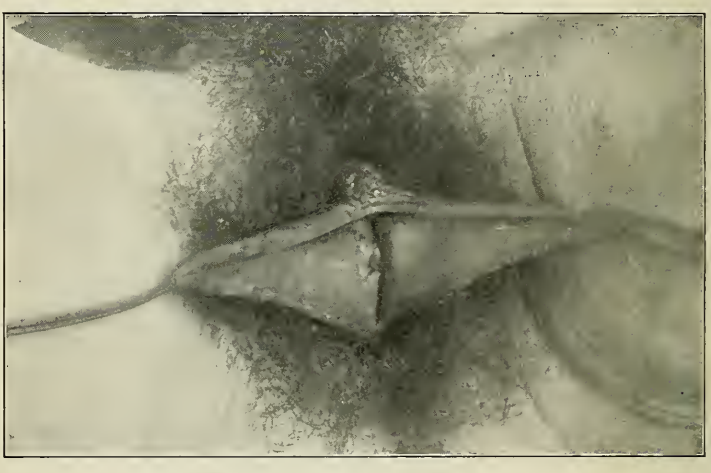


Fig. 36.—Hypertrophied nymphæ (author's case).

side, constituting the prepuce of the clitoris; the lower leaflet, with its other half, forming the frenum of the prepuce. Uniting below and to the outer side of the clitoris, the nymphæ run downward to merge into the labia majora at about their middle or lower third. The labia minora are often asymmetrical. They lie apposed to each other in the middle line, completely covered by the labia majora. They vary much in size. In some races (Hottentots) they are enormous, projecting far beyond the labia majora. As an exception this condition is sometimes seen in the Caucasian race. The skin of the nymphæ is in a transition stage between mucous membrane and skin. It merges on its outer side into the delicate skin of the inner surface of the labia majora, and on its inner side into the mucous membrane of the

vestibule. The venous spaces and the unstriped muscular fibers in the nymphæ resemble the structure of erectile tissue.

The vestibule is the space between the clitoris, nymphæ, and vaginal entrance. It is pierced in its mid-line by the urethral orifice,—the external meatus. The *bulbs of the vestibule* are two masses of venous plexuses about an inch long, lying along the sides of the vestibule below the clitoris and within the nymphæ. They are the homologues of the corpora spongiosa in the male. In sexual excitement, by muscular compression of their efferent vessels, they become turgid and erect.

The clitoris has the structure and anatomical features of the penis, but in miniature, and modified by the cleft below, the absence of the urethra, and the separation of the spongy bodies into the bulbs of the vestibule. The cavernous bodies of the clitoris are erectile. The glans of the clitoris is surrounded at its base by sebaceous follicles secreting a smegma, which may be confined by preputial adhesions, and is likely to cause irritation by its decomposition.

The urethral orifice or external urinary meatus is a round, slit-like or star-shaped opening on an eminence, usually crescentic in shape, sometimes with two lateral labia, occasionally surrounded by four tubercles. Directly below this eminence is the tubercle representing the end of the anterior column of the vagina. Just within the orifice of the urethra on its posterior wall are two efferent ducts (Skene's), 12–20 mm. long, communicating with small groups of tubular glands, said to be homologues of the prostatic glands.

Bartholin's glands, or the **vulvovaginal glands,** are mucoserous, racemose glands about a third of an inch in diameter, lying under the mucous membrane of the lateral vaginal walls and emptying by long, slender ducts below the vestibule and to either side of the vaginal entrance.

The Hymen.—The crescentic septum, occluding usually the posterior portion of the vaginal entrance, with the concavity of its opening directed upward, but presenting often an annular, cribriform, cordiform, crenelated, or cleft appearance, is a fold of mucous membrane reinforced by fibrous tissue, usually ruptured with ease, but occasionally so firm and unelastic that it even resists the impact of the descending head in labor. The hymen is usually torn at the first coitus, sometimes by gynecological examinations, or by masturbation. It is partially destroyed in labor, the remnants persisting as isolated protuberances around the vaginal orifice,—the carunculæ myrtiformes.

The Vagina.—The vagina is a musculomembranous canal extending from the hymen to the base of the vaginal portion of

the cervix uteri. The posterior wall of the canal is about 9 cm. (3.5 in.) long, the anterior 6.5 cm. (2.5 in.). The axis of the canal is slightly sigmoid in shape, but corresponds quite closely to the axis of the pelvic canal. The upper portion of the canal is expanded into the vaginal vault, the recesses being particularly well marked anteriorly and posteriorly, constituting the anterior and posterior fornices. The vagina, therefore, is flask-shaped. The vaginal walls are composed of three structures,—the mucous membrane, the muscular coat in two layers (the inner circular and the outer longitudinal), and a fibrous sheath. The anterior and posterior walls should be in contact, while the lateral walls are thrown into folds which give a transverse section of the vagina the shape of the letter H. The mucous membrane is covered with squamous epithelium, and with numerous papillæ, but has no glands except a few tubular structures in the upper part of the canal. The mucous membrane is thrown into numerous transverse folds or rugæ, most marked upon the anterior wall and in nulliparous women. There is an anterior and a posterior cord-like process in the median line, the anterior and posterior columns of the vagina, indicating the lines of junction of the ducts of Müller.

The Uterus.—The uterus is a hollow, muscular organ, in the adult virgin measuring 7.5 cm. (3 in.) in length, 4 cm. (1.6 in.) in breadth, and 2.5 cm. (1 in.) in its anteroposterior diameter. In shape the uterus is a flattened, pyriform body, the anterior wall being almost perfectly flat, the posterior more convex. It is divided into the body, the isthmus, and the neck, or cervix. The first occupies about three-fifths of its length, the last, two-fifths. In structure the uterus consists of a muscular wall with a mucous lining and a peritoneal covering. The muscle is unstriated and is arranged, roughly speaking, in three layers,—an external, a middle, and an internal. The middle layer constitutes the bulk of the wall; its fibers are arranged in a somewhat spiral form, though no very definite arrangement is to be distinguished. The fibers of the inner and outer layers are arranged in longitudinal and circular bands. The mucous membrane of the body of the uterus is composed of columnar, ciliated, epithelial cells, resting upon a delicate basement membrane. The cilia of the uterine epithelium lash in the same direction as those of the tubes, namely, from within outward, or from above downward.[1] As there is no submucous tissue, the mucosa of the uterus rests directly upon the muscle. The uterine mucous membrane is richly supplied with tubular glands, divided in their lower ends

[1] This has long been a disputed point. See Mandl, "Ueber die Richtung der Flimmerbewegung im menschlichen Uterus," "Centralbl. f. Gyn.," No. 13, 1898.

usually into two branches or forks. In the cervix the mucous membrane is thrown into longitudinal folds with lateral branches, —the arbor vitæ of the uterus. The epithelial cells in the upper two-thirds of the cervical canal are columnar, ciliated, in the lower third stratified, squamous cells. In addition to the tubular glands of the uterine body the cervical mucous membrane contains wide mucous crypts, the orifices of which easily become obstructed, so that they are converted into retention cysts, which commonly stud the cervix in cases of old inflammation or injury,—the glands or follicles of Naboth.

Fig. 37.—Perpendicular section through normal uterine mucous membrane; showing glands and interstitial tissue (Döderlein).

The uterine cavity is normally fusiform, widened in its upper part into a triangular space, most contracted below at the level of the internal os uteri. It has three openings, the internal os communicating with the cervical canal and the two uterine orifices of the Fallopian tubes. The cervical canal in the nulliparous woman is a slender ovoid in shape, contracted at its upper and lower boundaries,—the internal and the external os uteri. In a woman who has borne children the cervical canal is

often funnel-shaped, the external os, or the cavity just above it, being the most expanded portion.

The cervix itself is divided into two portions, the vaginal and the supravaginal. The former projects into the vaginal vault;

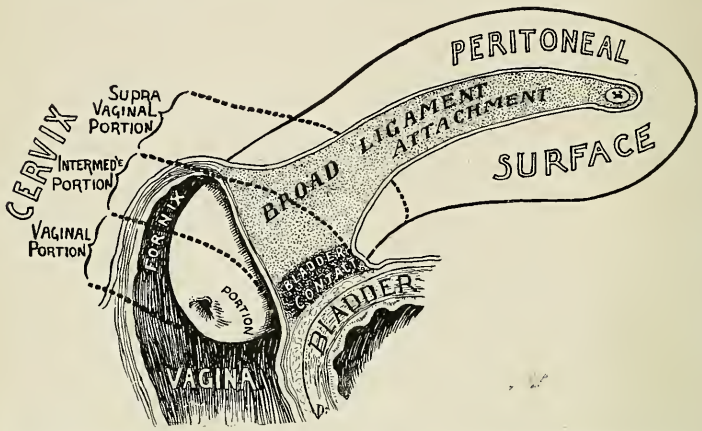


Fig. 38.—Diagram illustrating the relations of the uterus to the vagina, bladder, and peritoneum (Dickinson).

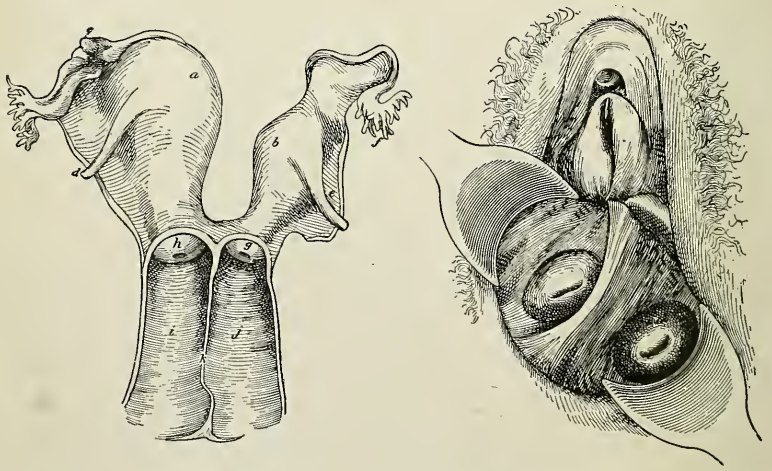


Fig. 39.—Uterus didelphys: *a*, Right segment; *b*, left segment; *c*, *d*, right ovary and round ligament; *f*, *e*, left ovary and round ligament; *g*, *j*, left cervix and vagina; *k*, vaginal septum; *h*, *i*, right cervix and vagina.

the latter is attached to the vaginal walls and extends a short distance above their attachments. The anatomist commonly speaks of the supravaginal portion as being entirely above the

vaginal attachments and extending to the isthmus. This view, however, is erroneous, as it assumes that the lower uterine segment is a part of the cervix.

It is usual to describe an anterior, shorter lip of the cervix and a longer posterior one. This description is more accurate in the parous woman with a bilateral tear of the cervix. As may be seen in figure 38, the supravaginal portion of the cervix is longer anteriorly than posteriorly. The normal position of the uterus

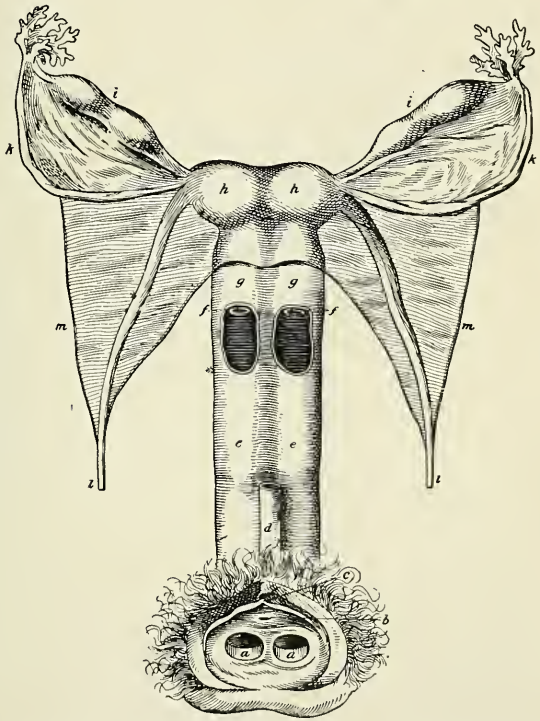


Fig. 40.—Uterus bicornis duplex: *a*, *a*, Double entrance to vagina; *b*, meatus urinarius; *c*, clitoris; *d*, urethra; *e*, *e*, double vagina; *f*, *f*, external orifices of uterus; *g*, *g*, double cervix; *h*, *h*, bodies and horns of uterus; *i*, *i*, ovaries; *k*, *k*, tubes; *l*, *l*, round ligaments; *m*, *m*, broad ligaments.

is almost horizontal as the woman stands erect. It is slung between the layers of the broad ligament, supported by lateral, anterior, and posterior musculofibrous bands and folds of peritoneum. It is so freely mobile that it rises and falls with every breath the woman draws.

The uterus is formed by the junction and fusion of the two ducts of Müller. An arrest of development in embryonal life

results in a partial junction or a complete failure to unite on the part of the Müllerian ducts. The consequent deformities of the uterus may occasion abnormalities in pregnancy or complications in labor and after-delivery. If there is complete disjunction of the

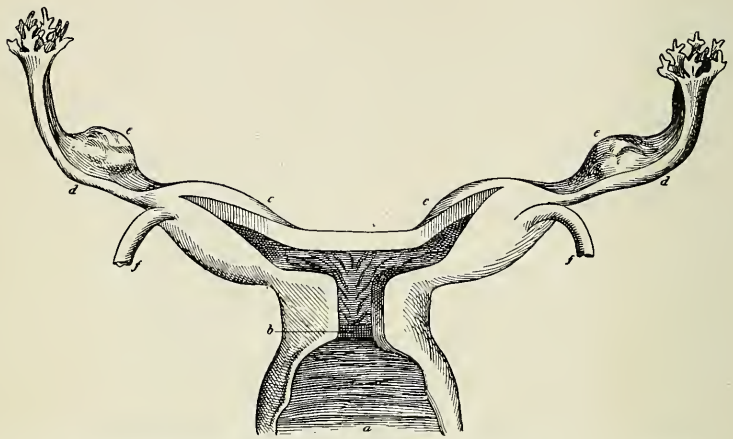


Fig. 41.—Uterus bicornis unicollis: *a*, Vagina; *b*, single neck; *c*, *c*, horns; *d*, *d*, tubes; *e*, *e*, ovaries; *f*, *f*, round ligaments.

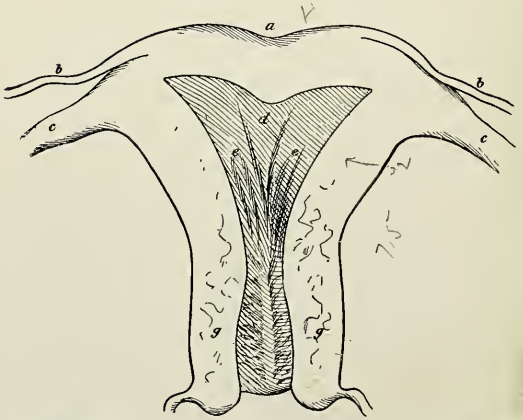


Fig. 42.—Uterus cordiformis: *a*, Indented fundus; *b*, *b*, tubes; *c*, *c*, round ligaments; *d*, central longitudinal ridge on posterior wall of uterine cavity; *e*, *e*, lateral ridges of same; *f*, internal os; *g*, *g*, cervix.

two ducts, the deformity is known as uterus didelphys (Fig. 39). If there is an outward junction but a complete disassociation of the two tubes except for their superficial union externally, the condition is called uterus bicornis duplex (Fig. 40). If there is a junction

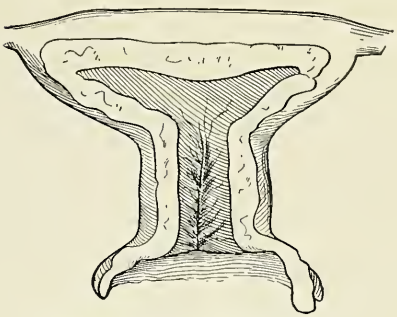


Fig. 43.—Uterus incudiformis.

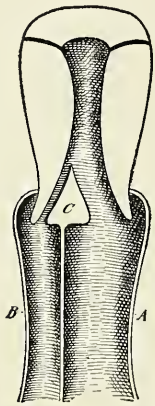


Fig. 44.—Schematic drawing of double vagina and single uterus: *A*, Left vagina; *B*, right vagina; *C*, cervical septum.

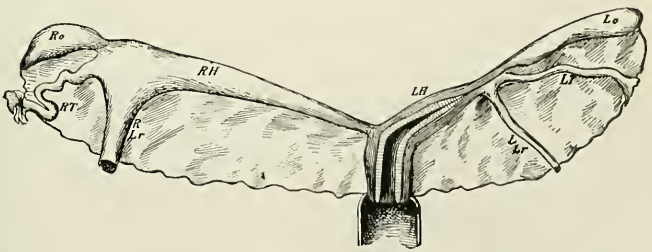


Fig. 45.—Uterus unicornis: *LH*, Left horn; *L T*, left tube; *Lo*, left ovary; *L Lr*, left round ligament; *RH*, right horn; *RT*, right tube; *Ro*, right ovary; *R Lr*, right round ligament.

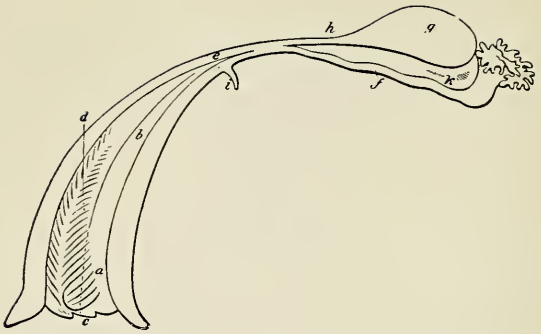


Fig. 46.—Ill-developed uterus unicornis: *a*, Cervix; *b*, fundus; *c*, *d*, longitudinal axis of uterine body; *e*, cornu; *f*, tube; *g*, ovary; *h*, ovarian ligament; *i*, round ligament; *k*, parovarium.

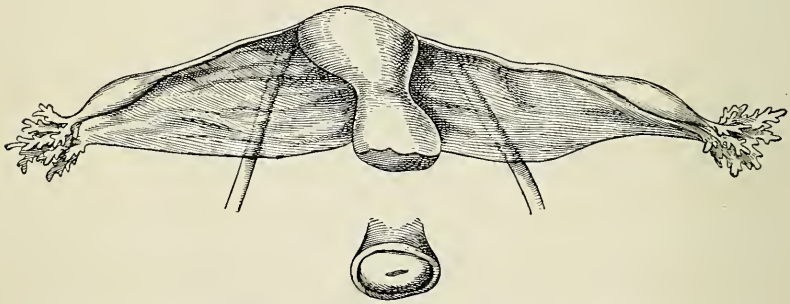


Fig. 47.—Ill development of right side of uterus; congenital lateral flexion.

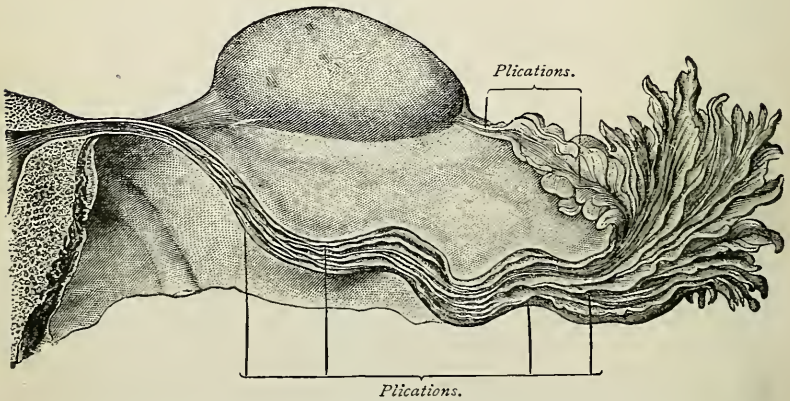


Fig. 48.—Longitudinal section of Fallopian tube, exposing the complicated longitudinal plications of the mucosa which expand into the fimbriæ (Sappey).

at the cervix but separation of the ducts above, there is a uterus bicornis unicollis (Fig. 41). There may be complete junction of the two Müllerian ducts, but the fusion of the two canals is incomplete; a uterus subseptus or semipartitus is the result. Finally, the form of the uterus may indicate its double origin: there may be a uterus cordiformis (Fig. 42) or a uterus incudiformis (Fig. 43). Occasionally one duct of Müller develops normally while the other is present as a mere rudiment. There is, in consequence, a uterus unicornis (Fig. 45).

The vagina is double in uterus didelphys and often in uterus bicornis duplex. The duplicity of the birth-canal may be confined to the vagina (double vagina) or it may affect the cervix without involving the rest of the uterus,—uterus biforis (Fig. 44).

The oviducts, or Fallopian tubes, are tubular structures about 10 or 12 cm. (3.93 or 4.5 in.) long, running from the cornua of the uterus at the upper edge and between the layers of the broad ligament outward, upward, and at their outer extremities downward and backward to the free surface of the ovary. The canal of the tube begins in the uterine wall as a fine opening (ostium internum); it expands to about 2 mm. (0.079 in.) in diameter, becomes wider as it runs outward, again contracts where it passes the ovary, widens again to a distinct opening 4 mm. (0.157 in.) in diameter (ostium abdominale) into the apex of the pavilion, or infundibulum, a funnel-shaped expansion at its outer extremity surrounded by fringed processes,—the fimbriæ.[1] The fimbriated extremity is connected with the ovary by the tubo-ovarian ligament.

The tube has three coats,—a mucous, muscular, and serous. The mucous membrane of the tube consists of a single layer of columnar, ciliated, epithelial cells, the cilia lashing toward the uterine cavity. The membrane is thrown into deep longitudinal folds, becoming more complex as the fimbriated extremity is approached. There are no glands in the mucous membrane. The muscular coat consists of circular fibers of unstriped muscle, with an outer, ill-developed layer of longitudinal fibers. The serous covering is continuous with the serous covering of the broad ligament.

The ovaries are almond-shaped bodies varying in size in different individuals and under different circumstances, but having average diameters of 3.5 cm. (1.38 in.) in length, 2 cm. (0.79 in.) in width, and 1.5 cm. (0.54 in.) in thickness. They are attached to the posterior layer of the broad ligament by the hilum. The ovary is a gland secreting eggs. It has, therefore, a gland-structure, stroma, parenchyma, and gland-spaces. There are, how-

[1] Older anatomists divided the tube into the isthmus, comprising the inner third, the ampulla, the outer or expanded portion, and the fimbriæ.

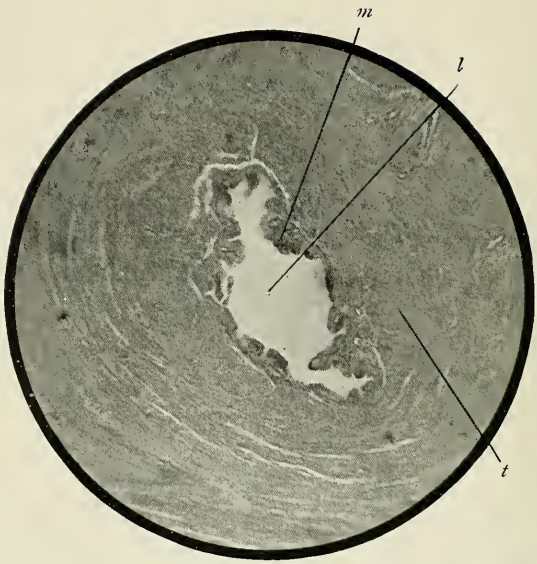


Fig. 49.—Normal Fallopian tube, uterine end: *m*, Mucosa; *l*, lumen of canal; *t*, tube-wall.

Fig. 50.—Normal Fallopian tube, section near abdominal end: *t*, Tubal wall; *v*, villus-like plications.

ever, certain distinctive peculiarities about this gland. It is not covered by peritoneum, but by a modified form of cells resembling those of mucous membrane,—the germinal epithelium. The gland-spaces have no ducts, but excrete their contents by a rupture of their walls. The body of the ovary is divided into a cortex and a medulla. The former contains the

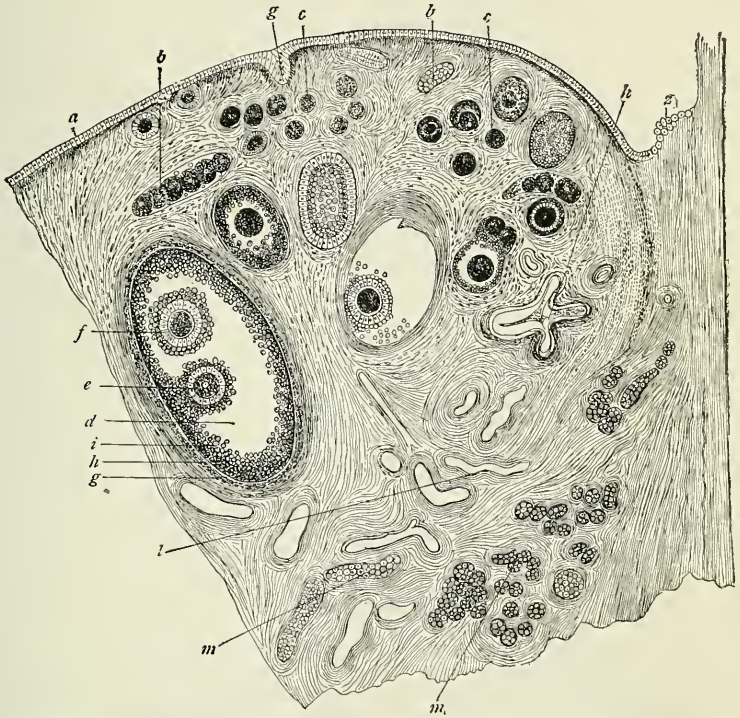


Fig. 51.—Section through part of ovary of adult bitch: *a*, Germinal epithelium; *b*, *b*, ingrowths (egg-tubes) from the germinal epithelium, seen in cross-section; *c*, *c*, young Graafian follicles in the cortical layer; *d*, a more mature follicle, containing two ova (this is rare); *e* and *f*, ova surrounded by cells of discus proligerus; *g*, *h*, outer and inner capsules of the follicle; *i*, membrana granulosa; *l*, blood-vessels; *m*, *m*, parovarium; *g*, germinal epithelium commencing to grow in and form an egg-tube; *z*, transition from peritoneal to germinal epithelium (from Waldeyer).

gland-spaces called Graafian follicles (after their discoverer, Regnier de Graaf, 1673, who thought they were ova), set in a stroma of spindle-shaped connective-tissue cells. The latter contain blood-vessels, nerves, a few muscle-fibers, and irregular groups of polyhedral cells (the interstitial cells), representing atrophic remains of the Wolffian bodies. Besides its connection with the

posterior layer of the broad ligament by the hilum, the ovary is attached to the uterus by the utero-ovarian ligament, to the tube by the tubo-ovarian ligament, and to the pelvic wall by the sus-

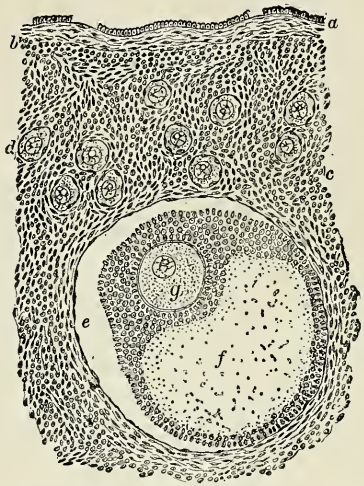
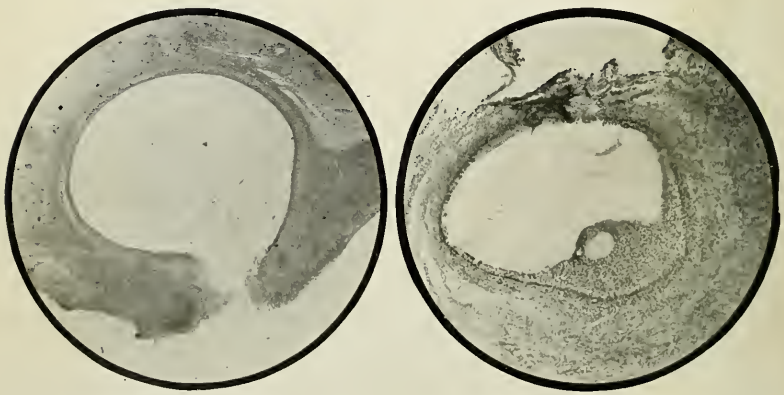


Fig. 52.—Section of human ovary, including cortex: *a*, Germinal epithelium of free surface; *b*, tunica albuginea; *c*, peripheral stroma containing immature Graafian follicles, *d*; *e*, well-advanced follicle from whose wall the membrana granulosa has partially separated; *f*, cavity of liquor folliculi; *g*, ovum surrounded by cell-mass constituting discus proligerus (Piersol).

pensory ligament of the ovary (ovario-pelvic, infundibulo-pelvic ligament).



A *B*

Fig. 53.—*A*, Recently ruptured Graafian follicle. *B*, Normal Graafian follicle about to rupture showing stigma (Micro-photographs prepared by McConnell and J. C. Hirst).

CHAPTER II.

Menstruation, Ovulation, Insemination, and Fertilization; The Changes in the Ovum After Fertilization.

MENSTRUATION.

Menstruation is the periodic discharge of a sanguineous fluid from the uterus, and perhaps from the Fallopian tubes, during the time of a woman's sexual activity, from puberty until the menopause. From the earliest ages of medical literature many theories have been advanced to account for menstruation. The oldest explanation was founded upon woman's supposed uncleanliness. Menstruation was thought to be an effort on the part of nature to rid the woman's body of noxious humors.[1] Again, it was explained that woman was plethoric and that nature provided a periodic vent for the superfluous blood. In modern times Pflüger has advanced the theory that menstruation occurs in consequence of a congestion brought about as follows: A Graafian follicle by its growth finally produces so great a reflex irritation as to determine a local congestion, which manifests itself in a bloody discharge from the uterine mucous membrane. Sigismund, Löwenhardt, and Reichert propounded the doctrine that menstruation occurs because the ovum discharged prior to the menstrual period is not impregnated; consequently, failing this stimulus to further growth and development, a retrograde change with bleeding occurs in the uterine mucous membrane. As a matter of fact, the cause of menstruation is one of the many life-phenomena at present beyond human comprehension. All that can be said is that a nervous influence proceeds periodically from the sympathetic ganglia in the lower abdomen and pelvis, stimulating and congesting the sexual organs. We can no more account for this nervous action than we can explain the nervous force which continues respiration from the moment of birth until death. Certain facts from comparative physiology, however, throw a glimmer of light upon the subject. For instance, it is

[1] Many popular superstitions are founded upon this idea; for example, that a drop of menstrual blood withers a flower, and that a menstruating woman in a dairy turns the milk sour. The modern physician is still influenced by this old superstition, if the author may judge from grave discussions he has heard as to the propriety of allowing a menstruating nurse to be present during the performance of an abdominal section.

asserted that if sheep fall into heat and are not gratified, the rut returns in a month. Menstruation in the female is obviously what rut is in the lower animals, and the bloody discharges from human females are probably the result of their erect posture and the pelvic congestion which is a consequence of it.

The mechanism of menstruation is better understood than its causes. It is mainly a diapedesis of blood through delicate new-formed capillaries in a thickened and congested endometrium, the provision for carrying blood to the membrane being better than that for bearing it away by the efferent vessels. Some of the newly formed delicate-walled capillaries no doubt rupture. Leopold has given the following description of the uterine mucous membrane during menstruation :

The mucous membrane is 8 mm. (0.315 in.) thick, swollen, dark brownish red, soft almost to liquefaction, but perfectly intact and separated by a sharply defined boundary-line from the paler muscular tissue of the uterus. The uterine glands, 0.5 to 0.75 mm. (0.0197 to 0.0296 in.) wide, are considerably lengthened and can be seen by the naked eye. In the superficial portion of the mucous membrane, which is very well preserved and only in certain spots lacks its epithelium and subjacent cells, may be seen an immense and enormously hypertrophied capillary network, the vessels of which have irregular outlines and lie in the uppermost layer of the mucous membrane.

Gebhard [1] gives the following results of his studies : About ten days before the menstruation there is a serous infiltration of the mucous membrane, separating the meshes of the stroma. Just before the flow there is a marked dilatation of the blood-vessels. The glands increase in size, become tortuous in their course, and are dilated by secretion. The swollen capillaries in part rupture, in part permit a transudation of blood. There is an extravasation infiltrating the stroma, forcing its way upward under the epithelium, which it raises from the subjacent tissues in little hillock-like projections. The blood escapes into the uterine cavity in two ways : First, it is pressed out between the epithelial cells of the intact mucosa ; second, the greater quantity by far makes its exit through openings formed by the separation of the cells on the summits of the hillocks just described. If the bleeding is profuse, epithelium may be carried away by the blood-stream. Exfoliation of the epithelium, however, is not the rule. After the exudation and transudation of blood ceases, the swollen membrane shrinks again, the epithelium sinks to its normal level and becomes attached to subjacent tissues. The extravasated blood in the stroma is absorbed.

[1] Veit's "Handbuch der Gynäkologie," vol. III.

From these observations of Leopold's and Gebhard's, and from other studies of mucous membrane removed by the curet during menstruation and observed in recently extirpated uteri, it appears that the theory of hemorrhage in consequence of degeneration of the mucous membrane is untenable.

The uterus is increased in size and softened in consistency, these changes being most marked just before the flow appears. The uterine cavity is enlarged, the cervix is slightly dilated, and the cervical glands secrete an increased amount of mucus. The tubes and ovaries are swollen, heavy, and congested.

There are certain clinical phenomena of menstruation which must often be taken into account by the physician.

Time of First Occurrence and of Cessation.—The onset of menstruation is influenced by race, climate, mode of life, heredity, and genital sense. In temperate climates and in the home of the Teutonic and Anglo-Saxon races, menstruation occurs oftener in the fifteenth than in any other year. In these same races transplanted to the eastern middle sea-board of the United States, menstruation appears a year or two earlier.

In Hungary the three races, Slavonic, Magyar, and Jewish, living side by side in the same climate, begin to menstruate, respectively, at sixteen, fifteen, and thirteen years of age. Hindu girls of Calcutta and negresses of Jamaica, living in similar climatic conditions, begin to menstruate at the eleventh and at the fifteenth year. Climate, however, does influence the onset of menstruation. It appears at eighteen years in the girls of Lapland and at ten years in Egypt and Sierra Leone.

The social conditions of a girl determine, to a certain extent, the age at which menstruation begins. If she lives in a city, subjected, perhaps, to indiscriminate association with the other sex and to sexual temptations, the function appears earlier than it does in the country, or in a girl carefully brought up in comparative seclusion. The same rule applies to lower animals. If a bull is admitted to the pasture of a herd of heifers, heat appears earlier in the latter than it would if they were segregated.

It is a matter of common observation that peculiarities of menstruation run in certain families. Thus, through several generations of females menstruation appears late and ends early, or *vice versâ*. By genital sense is meant the strength of sexual feeling. In women of strong sexual passion the function of menstruation is commonly instituted earlier and lasts to a greater age than common. Precocious menstruation is not uncommonly associated with nymphomania.

Menstrual Molimina.—By this term is meant the local and

reflex subjective symptoms of menstruation. There is a feeling of weight and heaviness in the pelvic organs, due to their congestion and increase of size. There is a general nervous excitation, so that women disposed to hysteria and epilepsy exhibit outbreaks at this and perhaps at no other time. The breasts swell and may secrete milk. The thyroid gland is enlarged and the tonsils are swollen, so that singers may lose their voice. There is increased vascular tension, increased activity of the heart, shown by sphygmographic tracings, and the pulse is accelerated. The temperature is elevated by 0.5° C. The skin is more vascular and shows unusual pigmentation, especially in the dark rings under the eyes. v. Ott has demonstrated a regularly recurring wave in all the physiological processes of women, shown by heat production, muscle strength, lung capacity, force of inspiration and expiration, and tendon reflexes. The greatest activity is manifested just before the appearance of the flow, when there is a sudden subsidence.

The Character of the Flow.—The discharge consists, in great part, of blood. It is alkaline in reaction. It contains, besides blood, mucous secretion from the glands along the genital canal and epithelial cells. It is dark in color, and should not clot. It has a peculiar odor from the secretions of the sebaceous glands at the vaginal outlet, excited, as are all the structures of the genital canal, to unusual activity.

The Duration of the Flow.—Menstruation rarely lasts less than three days; a continuance of four, five, or seven days, if the natural and invariable habit of the individual, may indicate nothing pathological. In the first two or three days the greatest amount of blood is lost. After that the discharge grows less until it ceases. A leukorrhea or mucous discharge for a day or two after the cessation of the bloody flow is common.

The Quantity of the Flow.—The actual quantity of discharge during menstruation has been estimated at four to six ounces. It is not practicable for the physician, however, accurately to measure the amount of flow. He must estimate it by the number of napkins worn in twenty-four hours. If a woman is obliged to change her napkins during the height of the flow more than three times a day, or to wear them double, the quantity of the flow is excessive.

The Cessation of the Flow.—The menstrual flow ceases usually in the forty-fifth year, becoming infrequent and more scanty over a period of six, nine, or twelve months, until it stops altogether. There are many exceptions, however, to this rule. A woman who begins to menstruate much later than the fifteenth year will often have the menopause before forty. Or, if she

begins to menstruate early, she will often continue beyond the forty-fifth year.

As a rule, therefore, it may be stated that a woman menstruates from about the fourteenth to the forty-fifth year of her age. Precocious menstruation, however, has been recorded in the infant of one or two years old, and the discharge has continued to the sixty-fifth and even to the eightieth year.

OVULATION.

By ovulation is meant the discharge of a mature ovum from its Graafian follicle. The study of the process involves a consideration of the development of the Graafian follicle and its rupture; the maturation of the ovum; the transmigration of the ovum from the surface of the ovary to the uterine cavity.

The Development of the Graafian Follicle and its Rupture.—The germinal epithelium on the surface of the ovary sends down into the ovarian stroma columnar prolongations called egg-cords. These cords become constricted at intervals, so that they are converted into a number of spherical gland-spaces unconnected with one another and without efferent ducts. The gland-space is surrounded by a containing membrane (the theca folliculi) divided into two layers,—the tunica fibrosa and the tunica propria. The interior of the gland-space is lined with a layer of epithelial cells,—the membrana granulosa. One of these cells, more highly specialized than the rest, the ovum (discovered by K. E. von Baer, 1827), is surrounded by an aggregation of the cells of the membrana granulosa,—the proligerous disc. The cavity of the gland-spaces is distended with fluid (the liquor folliculi) containing paralbumin. As the Graafian follicle develops, it retires deeper into the interior of the ovary, following the direction of least resistance. Finally, however, the most mature follicle, under the influence of premenstrual congestion, rapidly secretes liquor folliculi, swells to the size of a pea or a cherry, so that it stands out plainly from the surface of the ovary. On the most prominent portion of its free periphery the tunica propria fails at one spot (the stigma), so that the integrity of the follicle is preserved only by the tunica fibrosa, which soon gives way under the pressure imposed upon it from within, and the follicle ruptures. The ovum and surrounding discus proligerus, usually attached to the follicle-wall just under the stigma, are washed out into the free peritoneal cavity by the escaping liquor folliculi.

The Maturation of the Ovum.—The primordial ovum in

the immature Graafian follicle is an epithelial cell without a cell-wall, but with cell-contents called the yolk, a nucleus called the germinal vesicle, and a nucleolus called the germinal spot. As the ovum matures, it acquires a cell-wall with three coats or layers,—the zona pellucida, the vitelline membrane, and the internal cell-membrane. The human ovum is holoblastic,—that is, it completely segments,—and contains much more protoplasm, or germ-yolk, than deutoplasm, or food-yolk. In its maturation, or preparation for impregnation, the ovum shows the curious movement of its nucleus observable in all segmenting cells (karyokinesis), which approaches the cell-periphery, arranges itself in two star-shaped figures by the activity of the centrosome (the amphiaster stage), and extrudes portions of its substance as little globules (polar globules) upon the ovular surface, the chromatin in the nucleus dividing into sixteen chromosomes for the ovum and the same number for the polar globule at each extrusion of the latter. These globules then disappear and are lost. It is supposed that they contain, perhaps, substances which might unite with the female portions of the ovum to produce an imperfect being, as is done in certain hermaphroditic animals. Nature, it is presumed, takes this measure to prevent parthenogenesis, or the closest kind of inbreeding. A similar action may be observed in the spermatozoön during its development. After the extrusion of the polar globules the nucleus retreats into the interior of the ovum and becomes the female pronucleus. The chromosomes are reduced in number one-half, so that by a similar reduction in the male pronucleus the number characteristic of the human species, sixteen, is maintained when the two unite. The ovum is now ready for fertilization.

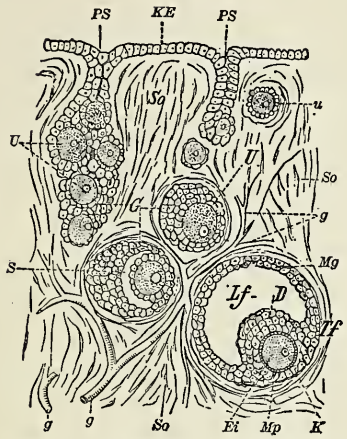


Fig. 54.—Section through part of a mammalian ovary: *KE*, Germinal epithelium; *PS*, an egg-cord; *U, U*, primitive ova; *G*, investing cells; *K*, germinal vesicle; *S*, follicular cavity arising in one of the older follicles; *Lf*, follicular cavity, more enlarged; *Ei*, nearly mature ovum, which has developed around it the zona pellucida, *Mp; Mg*, membrana granulosa; *D*, Discus proligerus; *So*, ovarian stroma; *Tf*, capsule of follicle; *g, g*, blood-vessels; *u*, immature Graafian follicle (after Wiedersheim).

The Discharge of the Ovum from the Ovary and its Migration to the Uterine Cavity.—Ova are discharged from the ovary from puberty until the menopause,—that is to say, on the average,

from the fourteenth to the forty-fifth year. Ovulation, however, may begin before menstruation, may cease before the menopause, or possibly may continue after it. A young girl has been impregnated as early as the ninth year.[1] In the child-marriages of

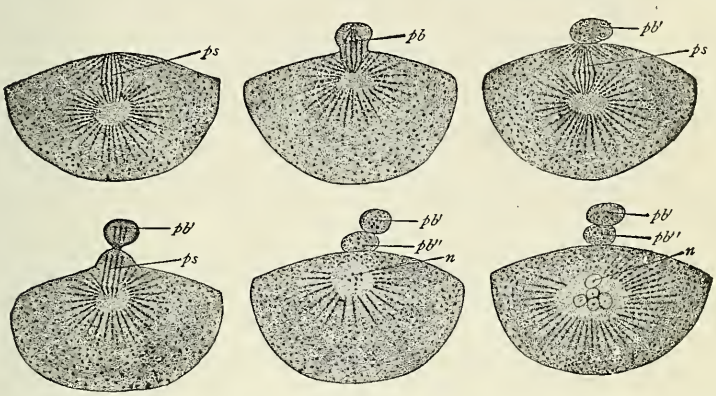


Fig. 55.—Formation of polar bodies in ova of *Asterias glacialis*: *ps*, Polar spinale; *pb'*, first polar body; *pb''*, second polar body; *n*, nucleus returning to condition of rest (Hertwig).

India impregnation has occurred before menstruation had begun; but usually premature maternity is preceded by precocious menstruation. Ovulation has continued, as proved by impregnation,

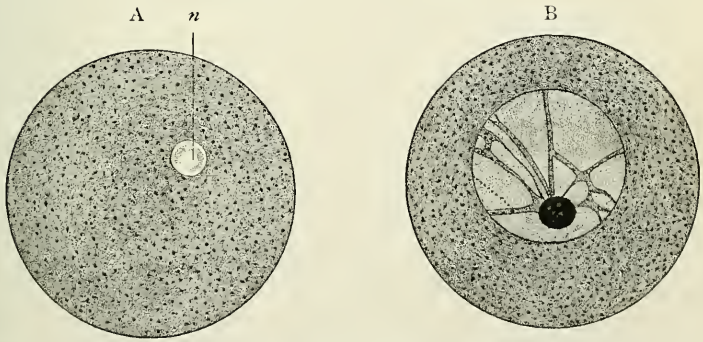


Fig. 56.—A, Mature ovum of echinus: *n*, female pronucleus; B, immature ovarian ovum of echinus (Hertwig).

until the fifty-second, fifty-fourth, fifty-eighth, and even to the sixtieth and sixty-second year! A case is recorded of delivery at the age of fifty-nine years and five months, and one at the age of sixty-

[1] Strassmann has collected six cases of precocious pregnancy from eight years and ten months to ten years of age. "Handbuch d. Geburtsh.," v. Winckel, vol. i, p. 91.

one.[1] A physician investigating the nature of an abdominal tumor should remember, therefore, that pregnancy is possible from the ninth to the sixty-second year. After the ovum is discharged from the ovary it is caught in a current of fluid moistening the surface of the ovary, and is carried to the interior of the corresponding tube. The existence of this current of fluid is explained by the movement of the ciliated epithelium in the tubes. In some animals there is a development of ciliated epithelium on the peritoneum at the time of ovulation. Arrived in the tube, the ovum is transported to the uterine cavity by the movement of the cilia on the epithelium and by the vermiform movements of the tubal walls. In certain cases of extra-uterine pregnancy an anomalous transmigration of the ovum has been demonstrated. Thus it is possible for the ovum, after its discharge from the ovary, to be taken up by the fimbriated extremity of the opposite tube,—an external transmigration of the ovum. It is also possible for the ovum to traverse one tube and the uterine cavity and to enter the uterine ostium of the opposite tube,—an internal transmigration of the ovum.

It has been calculated that the human ovary at birth contains 70,000 ova. As it is unlikely that any woman discharges many more than 360 ova, even if she ovulates uninterruptedly for thirty years, an enormous number of ova must atrophy, disintegrate, and disappear within the ovary.

THE CORPUS LUTEUM.

The changes which occur in the Graafian follicle after its rupture and the discharge of the ovum, discus proligerus, and liquor folliculi lead to a formation within the Graafian follicle called the corpus luteum.

There is an effusion of blood into the cavity of the follicle and an enormous development of the connective-tissue elements in the follicle-wall.[2] The internal layer of the theca folliculi is enormously thickened and thrown into numerous folds which eventually fill up the whole space in the interior of the follicle. The membrane is composed mainly of large hexagonal cells, like those of the liver, the lutein cells, containing a yellow substance—lutein—soluble in alcohol, and fat globules. The cells are separated by ray-like septa, extensions of fibro-connective tissue from the theca. Leopold thus describes the development of the typical corpus luteum: It appears on the first day as a follicle just broken open, the interior filled with blood. From the eighth day on there

[1] Strassmann quotes cases of impregnation at the sixty-second, sixty-third, and seventieth year. "Handbuch der Geburtsh.," v. Winckel, vol. i, p. 95.

[2] "The Origin, Growth, and Fate of the Corpus Luteum as Observed in the Ovary of the Pig and Man." J. G. Clark, "Johns Hopkins Hospital Reports," vol. vii.

appears a fine capsule around the blood-extravasation, while the inner portion becomes lighter and clearer. From the twelfth day the capsule grows thicker and is thrown into folds; from the sixteenth day it becomes a pale red, merging into a yellow. About the twentieth day the central matter of the broken follicle has become much shrunken, while the capsule, more decidedly a pale yellow, projects toward the center of the follicle in rays and narrow folds. The corpus luteum of menstruation, or the so-called false corpus luteum, reaches its highest development in ten to thirty days. Nine days later it is merely a lamina of fibrous tissue beneath a little pit or depression of the ovarian surface. The true corpus luteum of pregnancy, so called, is simply an exaggeration of the corpus luteum of menstruation, the longer growth and greater size being due to the stimulation and congestion of gestation. It grows for thirty or forty days after conception, occupying a third, perhaps, of the ovarian area. It then remains stationary until after the fourth month, when it begins to atrophy; at term it is only two-thirds its largest size; one month later it is reduced to a small mass of fibrous tissue. The true corpus luteum is of value as an indication of the ovary from which the impregnated ovule came. It should be remembered, however, that the ovaries of virgins have exhibited corpora lutea like those of pregnancy in consequence of intense and prolonged congestion.

It is claimed that there is a secretion from the corpus luteum which influences the nutrition of the uterus, the occurrence of menstruation, and the development of the ovum and of the uterus in early pregnancy. Experiments and observations of Fraenkel and others, it is asserted, demonstrate that an overproduction of lutein cells in the ovary causes a hyperplasia of the syncytial cells of the trophoblast and that a destruction of the corpus luteum in early pregnancy blights the ovum.[1] This statement has been denied, but it is now generally admitted that the corpus luteum is the most important source of the internal secretions of the ovum, and that these secretions not only influence the sexual organs of women, but have a peculiar influence upon the other organs with internal secretions, such as the pancreas.[2]

THE CONNECTION BETWEEN OVULATION AND MENSTRUATION.

Neither one of these functions is dependent upon the other, but they both depend upon a common cause,—the periodic nervous excitation and congestion due to an impulse from the

[1] Fraenkel: "Die Funktion des Corpus luteum," Arch. f. Gyn., Bd. lxviii.
[2] Rebaudi, Zentralbl. f. Gyn., No. 41, 1908.

sympathetic nervous system. Dependent as they are upon the same cause, their occurrence is usually synchronous,—that is, the ovule is discharged at the height of menstrual congestion. But this is by no means the invariable rule. Leopold,[1] in an examination of twenty-nine pairs of ovaries removed on successive days up to the thirty-fifth after a menstrual period, found a Graafian follicle bursting on the eighth, twelfth, fifteenth, sixteenth, eighteenth, twentieth, and thirty-fifth day after the menstrual period. In other words, ovulation may occur without menstruation at any time in the intermenstrual interval. In five cases there was no ovulation at the menstrual period, or menstruation occurred without ovulation. Many examples might be given, from clinical observation, of the mutual independence of these two functions. The common occurrence of impregnation during lactation is a good instance of ovulation without menstruation.[2] Menstruation after oöphorectomy and during the first three months of pregnancy occurs without ovulation. I attended, in her first childbirth, a young woman twenty-two years old, who had never menstruated. She had obviously, however, ovulated. In the child marriages of India impregnation has been known to precede menstruation. Renoudin saw pregnancy and labor in a woman sixty-one years old, who had ceased to menstruate twelve years before. Repeated ovulation without menstruation is seen also in those curious cases of postmarital amenorrhea, lasting for years. The wife of a physician among my acquaintances menstruated once after marriage; in the following fifteen years she bore ten children without ever menstruating. Three years after the birth of the last child, or eighteen years since its cessation, menstruation returned copiously and regularly, but more frequently than normal, for twelve years. The menopause then began, at the age of forty-eight.[3] A recent ovulation has been observed in an extra-uterine pregnancy of three months' duration (Slavjansky). Coitus four days postpartum has resulted in impregnation (Krönig).

It is sometimes necessary to resort to oöphorectomy in cases of ill-developed, infantile wombs, or entire absence of the uterus associated with well-developed ovaries, in which there is a violent exaggeration of the menstrual molimina every month without a discharge of blood and the consequent relief of menstrual conges-

[1] "Archiv f. Gyn.," Bd. xxix, S. 347.

[2] Remfry ("Revue internationale de Médicine et de la Chirurgie," 1896, No. 5) has found by an investigation among 900 nursing women that in 57 per cent. only did there occur an absolute amenorrhea. Menstruation was regular in 20 per cent. and irregular in 43 per cent. It was also common for conception to occur during lactation, 60 per cent. of the menstruating women conceiving. Among the non-menstruating women but 6 per cent. conceived during lactation.

[3] Similar cases are reported in "Amer. Jour. of Obstetrics," 1892, p. 352, and "N. Y. Med. Record," 1893, p. 717.

tion. The ovaries are found, after their removal, to be filled with well-developed Graafian follicles and numerous depressions representing corpora lutea. It may also be necessary to remove ovaries left in the abdomen in a hysterectomy possibly years before. The menstrual molimina are so severe as to cause occasionally hysterical convulsions.

INSEMINATION.

By the term insemination is meant the ejaculation of seminal fluid from the male organ and its deposition within the genital canal of the female. The study of insemination involves a consideration of the seminal fluid, the development and life-history of its active constituent (the spermatozoa), the mechanism of its ejaculation from the penis, and of its reception within the vagina and womb.

The seminal fluid is yellowish white in color, thick and sticky in consistency, varying in quantity at each emission from one-fourth to two drams. It possesses a peculiar odor and is neutral or alkaline in its reaction. The constituent parts, on chemical examination, are found to be water, eighty-two per cent.; salts, mainly phosphates; protein matter, fats, albumose, nuclein, lecithin, guanin, hypoxanthin, cholesterin, and spermatin. On microscopical examination there are seen seminal cells, crystals of phosphates, and *spermatozoa*, discovered by Hammen in 1677 and demonstrated to be the active principle in fertilization by the filtration experiments of Spallanzani and others. A spermatozoön is $\frac{1}{500}$ of an inch in length and possesses a power of motion by which it can travel with a rapidity variously estimated: its own length in a second, one inch in seven and one-half minutes (Henle), or from the hymen to the neck of the womb in three hours (Marion Sims). Spermatozoa have been found in the uterine cavity thirty minutes after a coitus (Schuwarski); in the tube sixteen hours post mortem in a prostitute who was killed during coitus. Strassmann calculates that they should make their way to the infundibulum of the tube in an hour and a half. Their progressive force is sufficient to overcome obstacles that appear insuperable; they may be seen, under the microscope, to push aside epithelial

Fig. 57. — Human spermatozoa: *A*, Spermatozoön seen *en face*; *h*, head; *m*, middle-piece; *t*, tail; *e*, end-piece; *B*, *C*, seen from the side (after Retzius).

cells ten times their size. Their vitality under favorable circumstances is remarkable. They have been found alive in the testicles of criminals who had been executed three days, and of bulls which had been killed six days before. In the cow they have been found six days after insemination; in a rabbit, eight days; in the female bat they may be found alive for months, and in the queen-bee for three years. In the human female living spermatic particles have been found in the vagina seven and one-half to

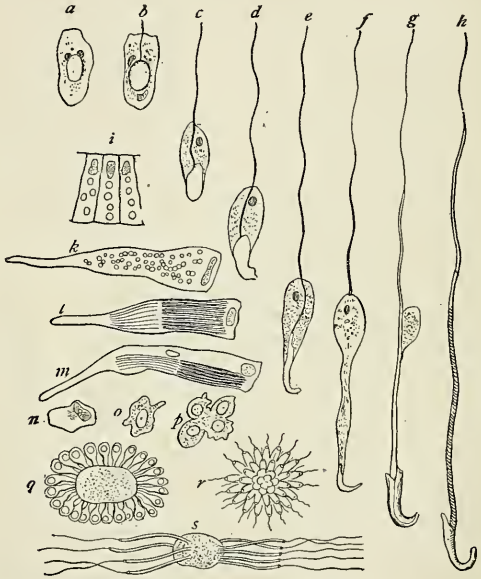


Fig. 58.—*a–h*, Isolated sperm-cells of the rat, showing the development of the spermatozoön and the gradual transformation of the nucleus into the spermatozoön head. In *g*, the seminal granule is being cast off (after H. H. Brown). *i–m*, Sperm-cells of an elasmobranch; the nucleus of each cell divides into a large number of daughter-nuclei, each of which becomes converted into the rod-shaped head of a spermatozoön (after Semper). *n*, Transverse section of a ripe cell, showing the bundle of spermatozoa and the passive nucleus (*i*, *n*, after Semper). *o–s*, Spermatogenesis in the earthworm; *o*, young sperm cell; *p*, the same divided into four; *q*, spermatophore with the central sperm-blastophore; *r*, a later stage; *s*, nearly mature spermatozoa (after Blomfield) (from Haddon).

seventeen days, in the cervical canal eight days after copulation.[1] They have been found alive in the tubes three and a half weeks after the last coitus (Dührssen), and have been kept alive in a culture-oven for eight days. On the contrary, they are extremely susceptible to certain unfavorable influences. They are destroyed by heat, cold, acid solutions, lack of water, and the mineral poi-

[1] "Handbuch d. Geb.," v. Winckel, vol. i, p. 146.

sons. A solution of bichlorid of mercury, 1 : 10,000, is fatal to them. As a consequence of chronic disease in the man, of alcoholic or sexual excess, or of catarrh of the seminal vesicles, the spermatozoa may be dead when emitted. As a result of inflammation and obliteration of the seminal ducts or of anatomical defects the seminal particles may be absent from the seminal fluid.

Lode estimates that there should be about 60,000 spermatozoa to the cubic millimeter of semen. Therefore millions of these bodies are deposited in the vagina at each coitus.

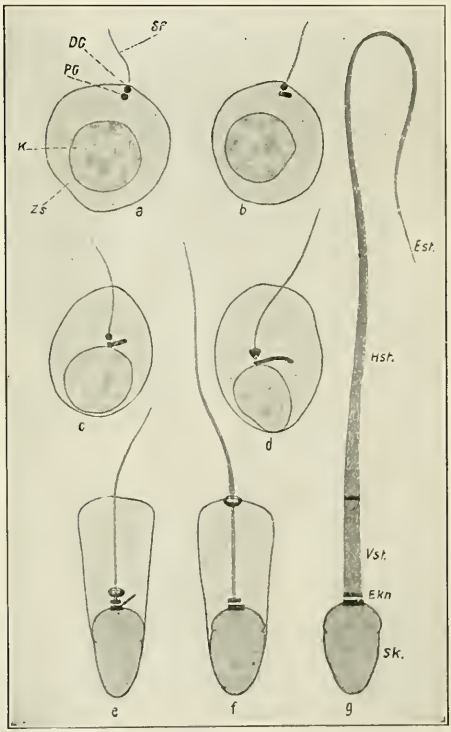


Fig. 59.—Seven stages of the conversion of a spermatic cell into a spermatozoön (Meves). Figs. *a* to *f*: *Zs*, Cell contents; *K*, nucleus; *PC*, proximal central body; *DC*, distal central body; *SF*, tail-piece. Fig. *g*: Head-piece; *Ekn*, neck; *Vst*, junction piece; *Hst*, main piece; *Est*, end-piece.

The indifferent constituent parts of the seminal fluid are derived from Cowper's glands, the prostate, and the vesiculæ seminales. The spermatozoa are developed from mother-cells, or spermatoblasts, specialized from the epithelium of the testicle. In the course of their development a portion of the cell is

extruded (seminal granule or accessory corpuscle) just as in the maturation of the ovum the polar globules are cast off. In the fully developed spermatozoön the head represents the nucleus of an epithelial cell, and the tail cell-contents specialized in the form of a cilium, of much larger size and greater power, however, than the cilia of ordinary ciliated epithelium.

Spermatic particles first appear in the seminal fluid at about the fifteenth or sixteenth year. There is often, in boys of twelve or thirteen, a seminal discharge, but it contains, as a rule, no spermatic particles. I have had charge, however, of a girl fourteen years of age impregnated by her brother, aged thirteen, who had stimulated his sexual development by masturbation. Spermatozoa often disappear from the sexual discharge of old men, but the age at which this disappearance occurs varies greatly. As a general rule it might be put down as sixty-five, but it will be remembered that the French engineer, de Lesseps, was a father at eighty-two, and that old Thomas Parr illegitimately impregnated a woman after he had passed his hundredth birthday.

The Mechanism of the Ejaculation of Seminal Fluid and of its Reception within the Genital Canal of the Female. —The mechanism of ejaculation is only understood by a study of the anatomy of the penis, which need not be considered here. It is sufficient to state that at the height of the orgasm in the male the seminal fluid is emitted by the action of the circular and longitudinal muscle-fibers of the vesiculæ seminales and of the urethra. The mechanism of the reception of the fluid within the genital canal of the female is a much more important matter to the obstetrician, for on a knowledge of this subject depends the comprehension of many a case of conception and of sterility.

It has been found, in studying the sexual congress of animals, especially in horses, that during the emission of semen and for a short time afterward the uterus exerts an intermittent suction, or aspiration action, upon the seminal fluid, drawing it into the uterine cavity. In the observation of sexual excitement in bitches it has been noticed that the uterus is drawn down into the small pelvis. In experimenting with the electrical stimulation of the sexual organs in female animals, it was observed that the uterus grew shorter, but broader; that it descended toward the vaginal outlet; that the cervix projected farther than normal into the vaginal canal, at the same time becoming softer and shorter, but broader, by which action the os uteri was opened. The stimulus being removed, the uterus returned to its normal condition and the os closed.

These interesting experiments upon animals have been confirmed by observations which gynecologists occasionally have the opportunity of making upon erotic females during a specular examination. It is justifiable, therefore, to state that in the orgasm a woman's uterus becomes broader and shorter; that it descends into the small pelvis; that the cervix projects into the vagina, becomes broader, shorter, and softer, and that the os opens; these actions being intermittent, the uterus might be likened to an animal gasping for breath. It would appear that the intention of this action is to suck the seminal fluid directly into the uterine cavity. The postmortem examination of two women murdered at the conclusion of a copulation in whom the uterine cavity was found full of seminal fluid does not, therefore, seem necessarily apocryphal, though the reports date from an unscientific age, and have been used as the foundation of absurd theories.[1]

A perfectly normal and typical mechanism of the reception of seminal fluid may be thus briefly described: The orgasm of male and female should be synchronous; as the seminal fluid is ejaculated from the penis it is, if not actually sucked in part into the uterine cavity, at least by the extrusion and retraction of the mucous plug of the cervix, drawn in part into the cervical canal. An absolutely normal mechanism, however, is not always necessary to impregnation, though a lack of it explains some cases of sterility. One of my patients bore a child within a year after marriage and then remained sterile for six years. During the whole of this time she did not once experience sexual excitement during intercourse. Finally, for the first time in six years there was an orgasm, and it was synchronous with the husband's. This coitus proved fruitful. The resultant pregnancy, curiously enough, was tubal. There are many women who have absolutely no sexual feeling and who never experience an orgasm, but who, nevertheless, become pregnant repeatedly. Insemination has occurred also when the woman was asleep, drunk, asphyxiated, or unconscious from some other cause. These cases are explained by the deposition of semen in the vault of the vagina, in what is called the seminal lake, into which the cervix projects. The spermatozoa, attracted by the alkalinity of the cervical mucus and repelled by the acidity of the vaginal secretions, make their way through the cervical canal into the uterus. This explanation presupposes a normal position of the uterus. A retroverted uterus, therefore, with the cervix tilted so far forward that it is not bathed in the seminal lake, is often, but

[1] See Janke, "Hervorbringung des Geschlechts," Berlin and Leipsic, 1887.

not necessarily, a bar to conception. The motility of the spermatozoa enables them to penetrate the canal, although it may be difficult of access. Retroversion, however, is a cause of sterility. One of my patients bore a child and was sterile for five years afterward. On examining her to discover the cause of her sterility, I found a complete retroversion. The malposition was corrected and the uterus was supported with a pessary. In the next six years that woman bore five children. The motility of the spermatozoa accounts, too, for the cases of conception without insemination at all,—that is, after a mere deposition of seminal fluid upon the external genitals. I have attended in confinement two married women with unruptured hymens, and on one occasion examined a young, unmarried girl with a perfectly intact, though delicate hymen, who had been impregnated, during an embrace by her lover in the erect posture, from the deposition of semen upon the labia majora.

The Meeting Place of Ovule and Spermatic Particle.—It is generally assumed that the spermatozoa meet the ovule in the ampulla of the tube. That this may be the meeting place is

Fig. 60.—Portions of the ova of *Asterias glacialis*, showing the approach and fusion of the spermatozoön with the ovum: *a*, Fertilizing male element; *b*, elevation of protoplasm of egg; *b'*, *b''*, stages of fusion of the head of the spermatozoön with the ovum (Hertwig).

proved by cases of tubal pregnancy. There are arguments, however, in favor of the fundus uteri as the normal meeting place of spermatic particle and ovule. If ovulation occurs at the height of menstrual congestion, the ovule has probably reached the uterine cavity before the fruitful coitus occurs. Hyrtl[1] found the ovule in the uterine extremity of the tube in a girl who had died on the fourth day of menstruation. In Jewesses, who are proverbially prolific, copulation is not allowed until a week after the cessation of menstruation. It is almost inconceivable that the

[1] Müller's "Handbuch," vol. i, p. 151.

PLATE I.

26. Two ova with surrounding membrana granulosa in the Fallopian tube.
27. The spermatozoon, having entered the ovum, the head is swollen.
28. Ovum in dyaster stage of mitosis for first polar body.
29. The second polar spindle, placed obliquely. Chromosomes undivided. The polar body with some chromosomes, discharged.
30. Dispirem stage of the second polar mitosis with mid-body in central spindle.
31. Ovum with pronucleus.
32. Ovum with pronucleus; large nucleolus in sperm nucleus.
33. Chromosomes forming in the pronuclei.
34. The spirem with centrosome.
35. Ovum with first segmentation-mitosis.
36. Ovum in dyaster stage of the first segmentation-mitosis.
37. Ovum in dispirem stage of the first segmentation-mitosis.
38. Ovum with twelve segmentation-spheres (blastomeres); mitosis in two of them.
39. Unimpregnated ovum in the Fallopian tube on the third day after ovulation.

Chs, Chromosomes; *ek*, nucleus; *rk*, rk_1, rk_2, polar bodies; *schw*, tail of a spermatozoon; *spk*, sperm-nucleus (Sobotta).

PLATE I.

26.
27.
schw.
28.
rk.
spk.
29.
chs.
rk.
30.
rk.
31.
rk.
rk.
ek.
spk.
32.
spk.
ek.
33.
34.
35.
36.
37.
38.
39

ovum has not reached the uterine cavity by this time. It is, however, a disputed point whether the impregnated ovum dates from the last or the expected and missed period. The question is not yet decided, and the student is at liberty to adopt the view most acceptable to his reason. My own belief is that it is not the ovum of the last period which is impregnated.

The Fertilization of the Ovum.—From what has been seen in the lower animals and in the vegetable kingdom, it is probable that the ovum, during its passage through the tube or on its arrival

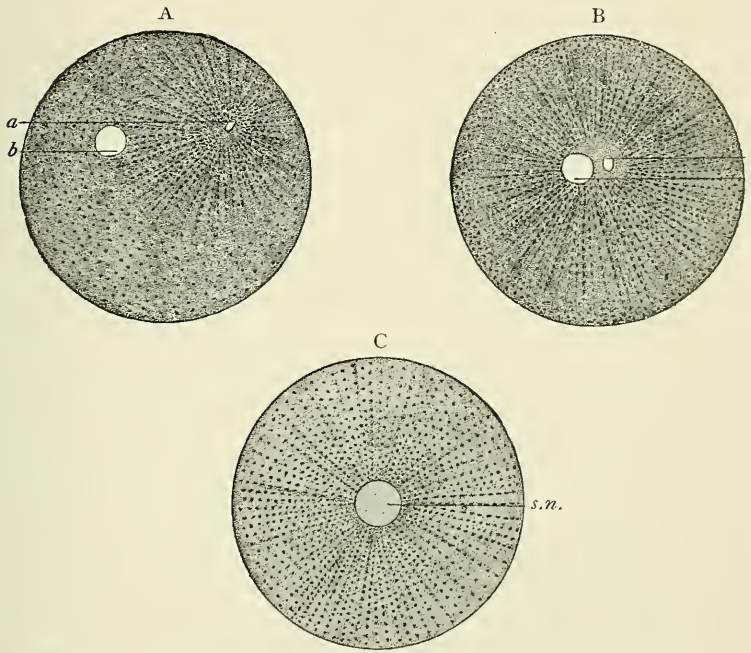
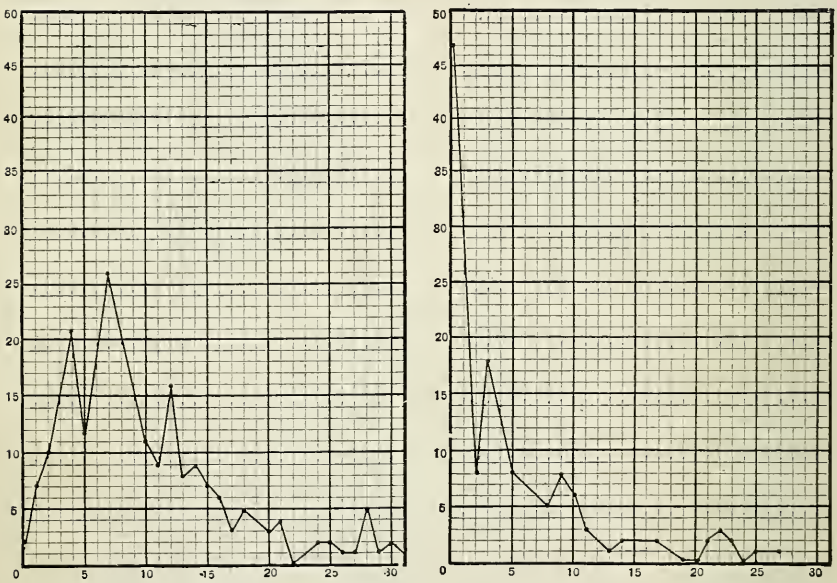


Fig. 61.—A, Fertilized ova of echinus: The male. *a*, and the female pronucleus, *b*, are approaching; in B, they have almost fused; C, ovum of echinus after completion of fertilization; *s.n.*, segmentation-nucleus (Hertwig).

in the uterine cavity, excretes some material which attracts the spermatic particles, as the female elements of some plants attract the male elements by an excretion of malic acid. From the swarm of spermatozoa around it a number may penetrate the cell-wall of the ovum, but only one, as a rule, penetrates the cell-contents. From what is seen in sea-urchins it is claimed that two or more spermatozoa may enter the ovum through the same opening in the cell periphery, especially if it is immature or atrophic, and that thus multiple pregnancy may result. The

female pronucleus divides into as many portions as there are male pronuclei. The mechanism of ovular penetration is as follows: the head of the spermatozoön fuses with a projection from the protoplasm of the ovum; the tail disappears. The head then penetrates the cell-contents and becomes the male pronucleus,—a small, oval body (containing the chromatin of the male cell) with a striated arrangement of cell-contents about it derived from the centrosome. Finally, the male pronucleus unites with the female pronucleus. Conception occurs at the moment of this union, and from this instant dates the life-beginning of the future embryo, fetus, and infant.



Figs. 62 and 63.—Curves showing relative frequency of conception following coitus at different times in relation to menstruation. In both diagrams the divisions on the abscissa line correspond to days: in the first, to days after the onset of menstruation; in the second, to days after the cessation of menstruation. The curves indicate the proportion of conceptions to copulations on each day of the menstrual month (Hensen).

The Time when Coitus is Most Likely to Result in Conception.—Statistical studies show that impregnation is most likely to occur after copulation during the first eight days succeeding the cessation of menstruation. There is a period, beginning fourteen days after the cessation of menstruation and lasting for a week, during which coitus is least likely to be followed by conception. Some women claim that they can avoid impregnation or become pregnant at will, by following or disregarding this rule.

As any woman, however, may ovulate at any time during the intermenstrual period, and as spermatozoa may retain their vitality for more than three weeks in the Fallopian tubes, this method of preventing conception is by no means invariably reliable.

The Average Date of Conception after Marriage.—Normally, impregnation should succeed the first menstruation following marriage, but marriages are only called sterile after eighteen months have elapsed without conception. Pregnancy is possible, however, after years of sterility. The author has had charge of women who conceived for the first time nine, thirteen, and twenty-four years after marriage.

THE CAUSES AND TREATMENT OF STERILITY.

In at least 20 per cent. of sterile marriages the fault lies with the male. His spermatozoa should be examined under the microscope and his *potentia cœundi* should be ascertained in every case as part of the routine investigation of sterility in the female. The causes of sterility in the wife may be classified as follows:

Anatomical or developmental defects preventing normal insemination or presenting mechanical obstacles to the access of the spermatozoa to the ovum. Atresia or stenosis of any part of the genital tract, absence or arrested development of the ovaries may prevent impregnation. The commonest development anomaly responsible for sterility is stenosis of the cervical canal and a U-shaped anteflexion of the uterus.

Diseases, injuries, and displacements of the vulva, such as vaginismus, kraurosis, and neoplasms may prevent normal insemination, and are usually, but not necessarily, a bar to conception, the mere deposition of semen upon the external genitals being followed sometimes by impregnation. An injury of the vulva which the author has twice seen responsible for sterility is a perforation of the fossa navicularis into the rectum at the first coitus, the hymen remaining intact. Subsequent intercourse occurred by way of the fistula.

Stenosis of the vagina may prevent conception. In a case of the author's, however, with the vagina reduced by acquired stenosis to a narrow sinus throughout its whole length, barely admitting a surgeon's probe, impregnation occurred by the deposition of semen upon the vulva. Coitus in such cases has not infrequently been practised by the urethra, which has been gradually dilated. With a coincident vesicovaginal fistula above the site of complete atresia impregnation is possible and has occurred. Injury of the pelvic floor, destruction of the perineum, inversion of the vagina, may be causes of sterility by preventing the retention of seminal fluid.

Retroversion of the uterus may be, but is by no means necessarily, a cause of sterility. In the supine position the cervix is tilted upward and is not bathed as it should be in the seminal lake occupying the posterior vault of the vagina. The motility of the spermatozoa may overcome the obstacle, but cases of sterility are cured sometimes by a pessary or the operative treatment of retroversion.

A complete prolapse of the uterus usually prevents conception, but in a case of the author's impregnation took place in spite of a total prolapse of years' duration. A fibromyoma or other neoplasm of the uterus or of the endometrium may prevent conception by opposing obstacles to the ascent of the spermatozoa, but the motility of the latter may enable them to surmount barriers mountains high in comparison with their microscopical size and to traverse the most tortuous canal.

Endometritis with a profuse mucopurulent leukorrhea may prevent conception, but there is often an associated salpingitis which is the real bar to impregnation. An intensely acid discharge from the cervix may be inimical to the activity or the existence of the spermatozoa.

The commonest disease of the genitalia accountable for sterility is salpingitis, with closure of the abdominal ostium by adhesive inflammation. The common cases of "one-child sterility" are usually due to this cause, and it also explains the infrequency of conception in prostitutes. Diseases and neoplasms of the ovaries, destroying them as egg-producing glands, their inclosure in an adventitia of inflammatory exudate, and a thickening of the proper capsule, prevent ovulation and, therefore, preclude conception.

Anemia and wasting diseases may deprive the Graafian follicles of the blood required for their maturation and rupture and so may prevent ovulation.

The Psychic Causes of Sterility.—It is true that women may be impregnated while asleep, drunk, asphyxiated, or unconscious from any cause ; by the mere deposition of semen upon the external genitalia; by the artificial injection of seminal fluid into the genitalia; without ever experiencing the least sexual sensation. Nevertheless, a lack of affinity between the man and woman, an absence of sexual passion and of an orgasm, may account for sterility.

Treatment.—It is obvious that the treatment must be directed to the cause and must vary greatly in individual cases. A careful study of the patient should naturally precede the treatment. The case may call for the removal of tumors from the vulva; the cure, if possible, of kraurosis; the gradual dilatation of the introitus

vaginæ; the destruction of sensitive papillæ around the vaginal introitus by the electro-cautery needle, or cutting the levator ani muscles in vaginismus; the correction of atresia or stenosis in the genital canal; the excision of the hymen and the closure of fistulæ; the repair of vaginal injuries, or the reposition of a displaced uterus. A thorough dilatation of the cervical canal cures more cases of sterility than any other single procedure. The most efficient and permanent dilatation of the cervix is effected by the author's modification of Schatz's metranoikter (see p. 789). The restoration of patency in the tubes stands next in order of efficiency among the operations for sterility (see p. 909). The assumption of the knee-chest posture after coitus may be recommended. A tonic treatment for anemia may be indicated. An improvement of general health and strength by travel, open-air exercise, and a generous diet will sometimes be successful when local treatment has failed. Experiments upon the lower animals, as well as upon human beings, have demonstrated the possibility of transplanting the ovary to some other situation than its normal one in the peritoneal cavity, or even of implanting the ovary recently removed from another person with continued functional activity and a subsequent conception.

A myomectomy or the removal of any pelvic or abdominal tumor exerting pressure upon the genital canal may prove the obstacle to conception.[1] If there is uterine or cervical leukorrhea, a curettage and applications of antiseptics or astringents to the endometrium are indicated. If the uterine discharge is intensely acid, it is claimed that intra-uterine applications of milk of magnesia shortly before coitus make conception possible.

A gouty diathesis sometimes associated with this acid discharge should be treated appropriately. From their nature many cases are incurable. Occasionally a marriage sterile for many years may inexplicably prove fruitful without special treatment. The author has had under his charge in confinement a woman who conceived for the first time after more than twenty years of married life, when she had given up all hope of such an event. The physician should usually be careful not to inform his patient bluntly that she is hopelessly sterile. She should be allowed to entertain some hope of maternity until the lapse of years has reconciled her to the idea that she can not expect offspring.

[1] In a case of sterility of thirteen years' duration I removed 5 myomata by myomectomy. Impregnation occurred in three months.

CHANGES IN THE OVUM FOLLOWING IMPREGNATION.[1]

Directly after the formation of the nucleus of segmentation by the fusion of male and female pronucleus the ovum begins to segment. The original mass divides itself into two cells (blastomeres), these into four, and so on until the whole ovum is surrounded by a layer of cells inclosing a group of somewhat larger cells (morula, or mulberry mass), and a hollow cavity containing albuminous fluid. This stage of development is called the blastula, or blastodermic vesicle. The cells of the ovum next arrange themselves into a thinned-out, laminated layer around the periphery of the ovum, and another layer just within this, the offspring of the central mass of cells (the ectoderm), and the proliferating central mass itself, — the entoderm. Regarding the surface of the ovum, an oval, opaque region may be observed (the embryonal area), and in the middle of this area a streak of greater opacity appears,—the primitive streak. At the site of this streak a depression next appears,—the primitive groove. A microscopic examination of a section through this region now shows the development of a median layer of cells (the mesoderm), made up of cells derived in part from a layer furnished by the ectoderm and by another fur-

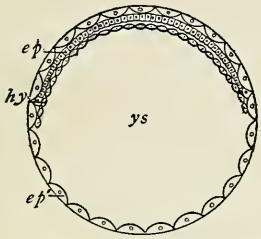


Fig. 64.—Diagrammatic section of a mammalian blastoderm after the cover-cells have completely closed in the blastoderm, and the embryo proper has become two-layered: *ep'*, Non-embryonic epiblast; *ep*, embryonic epiblast; *hy*, hypoblast; *ys*, yolk-sac (from Haddon).

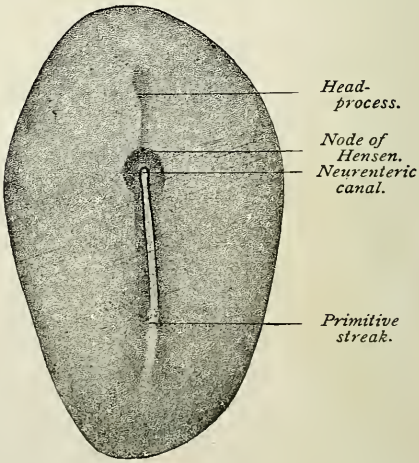
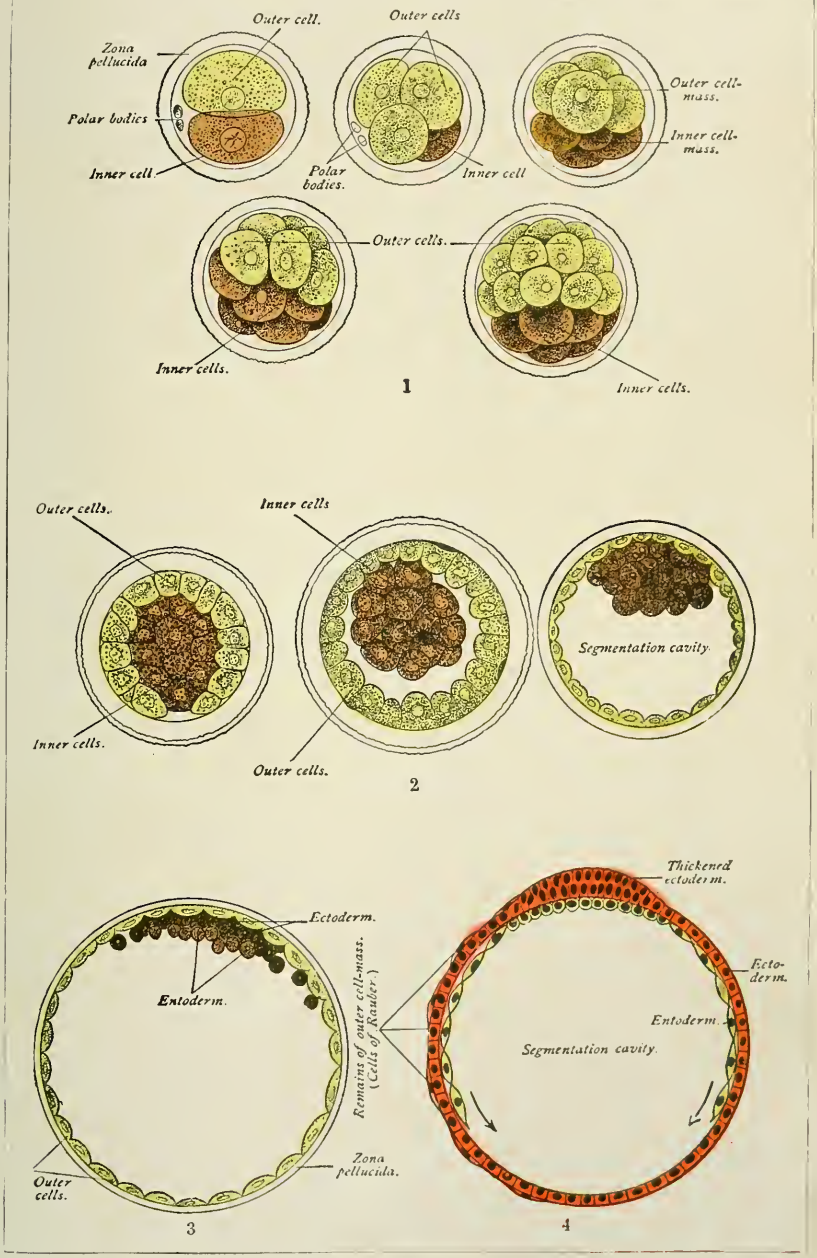


Fig. 65.—Embryonic area of rabbit embryo: Primitive streak beginning in cell-proliferation, known as the "node of Hensen" (E. v. Beneden).

[1] It is not intended to give more than a mere sketch of the development of the embryo. The student interested in the subject is referred to special works, such as Minot's "Embryology."



1, 2, 3. Diagrams illustrating the segmentation of the mammalian ovum (Allen Thomson, after van Beneden). 4. Diagram illustrating the relation of the primary layers of the blastoderm, the segmentation-cavity of this stage corresponding with the archenteron of amphioxus (Bonnet).

nished by the entoderm. In the course of its development the mesoderm develops lateral reduplications and parts into two layers (the parietal and visceral layers) inclosing spaces,—the body-cavity, or celom (Fig. 66). The parietal or somatic layer unites with the ectoderm to form the somatopleure. The

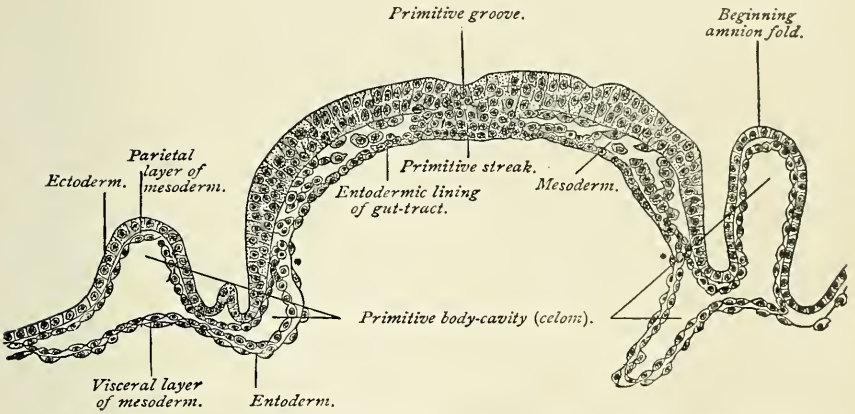


Fig. 66.—Transverse section of the embryonic area of a fourteen-and-a-half-day ovum of sheep (Bonnet).

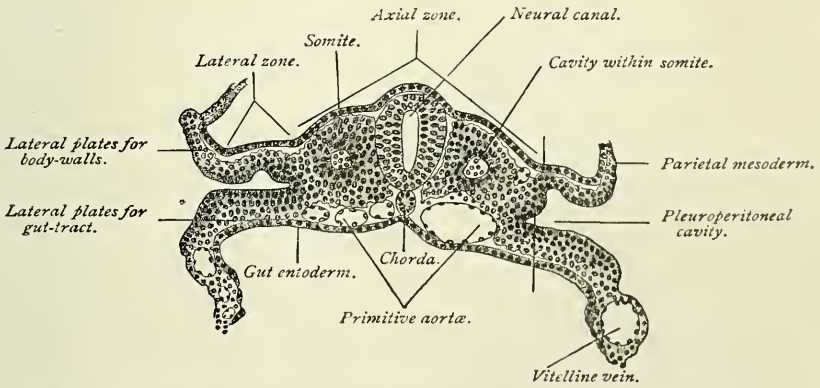


Fig. 67.—Transverse section of a seventeen-and-a-half-day sheep embryo (Bonnet).

visceral or splanchnic layer joins the entoderm to form the splanchnopleure. At the end of the second week the development of the embryo proper begins, by the formation of the neural folds, the neural canal, the chorda dorsalis, or notochord, and the somites, or provertebræ. The normal development of the embryonal body now depends, in its gross features, upon an arching-over process of cells which inclose

the spinal canal, the abdominal and thoracic cavities, and the cranial cavity. An arrest in these developmental processes results in such deformities as spina bifida, exomphalos, celosoma, hydrencephalocele, and anencephalia.

Assuming that impregnation occurs in the ampulla of the tube, some five to seven days elapse before the ovum arrives in the uterine cavity. The implantation of the ovum in the uterine mucous membrane occurs in the following manner: Either by pressure or by an active erosion of the uterine cells by the primitive peripheral cells of the ovum the epithelium of the endometrium is penetrated, and the ovum imbeds itself in the connective tissue of the mucosa, the epithelium closing over it again and thus excluding it from the uterine cavity (Peters).

CHAPTER III.

The Development of the Embryo and Fetus.

The changes in the developing embryo and fetus [1] from month to month have practical value for the obstetrician when he would determine the probable date of impregnation from the appearance of the cast-off ovum. The intelligent explanation of many congenital deformities and intra-uterine accidents and diseases also depends upon a knowledge of intra-uterine development.

First Month.—Direct observation of the human ovum during and shortly after impregnation fails us. The theories as to the site in which this phenomenon occurs, as to the changes that immediately succeed it, are based upon what has been actually seen in the lower animals, and upon the clinical history of pregnancies in which the ovum is developed in an unnatural situation. Thus it is argued that the spermatic particle must penetrate the ovule shortly after its escape from the Graafian follicle, for the occasional occurrence of abdominal and tubal pregnancies proves that the spermatozoa can make their way far into the tube and even on to the surface of the ovary; and what is seen in animals makes it probable at least that the outer coating of the ovule, during its passage through the tube, receives an additional thickness from an albuminous deposit upon it, or that the original cell-wall becomes denser and tougher by a process

[1] The usual plan of calling the product of conception "embryo" for the first three months, and afterward "fetus," is the one adopted here.

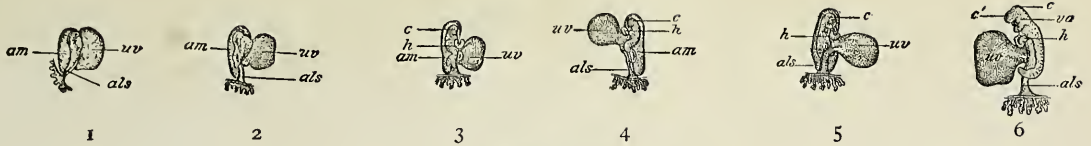
of coagulation; either of which conditions would render the penetration of the ovule by a spermatic particle unlikely, if not impossible. On the other hand, it is claimed [1] that if the ovule escapes from the ovary at the beginning of the menstrual flow, and if the fruitful coition occurs only some days after menstruation has ceased, as is common at least among civilized people, the time that intervenes between the rupture of the Graafian follicle and the deposition of semen in the female genital tract has been too great for the ovule to remain in the ovarian extremity of the oviduct, but, on the contrary, insures its presence in the uterine cavity. It is asserted that the rhythmical contraction of the muscles in the tubal walls which drives the exuded menstrual blood, as well as the ovule, toward the uterus, offers an additional barrier to the ascent of the spermatozoids. This argument is invalidated, however, by the occasional occurrence of extra-uterine pregnancy. The old explanation of the migration of the ovum to the abdominal orifice of the tube was that the fimbriated extremity of the latter became "erected" at the time the ovule escaped, and grasped with its fimbriæ the surface of the ovary, thus displaying a sort of independent intelligence. The anatomical impossibility of the fimbriæ being closely and accurately applied to the surface of the ovary has been demonstrated,[2] and the tube contains no true erectile tissue; this theory, therefore, has long been exploded. The fact that the fimbriæ are provided with ciliated epithelial cells which work actively toward the uterus, and create a stream in the moisture which is always present upon the peritoneal surface, accounts for the transference of the ovule from the ovary to the oviduct. The ovule, being discharged from the Graafian follicle, is either brought directly in contact with the cilia of a fimbria, or else, dropping upon the peritoneum, it is caught in the gentle current of a minute quantity of fluid that always bathes that membrane, and is so conveyed to the wide opening of the abdominal end of the oviduct. This explanation also accounts for the so-called "external migration" of the ovule, which, discharged from an ovary and failing for some reason to be taken up by the corresponding tube, finds its way to the opposite tube,—an occurrence that has been observed in certain cases of tubal pregnancy.[3]

[1] See Wyder: "Beitr. zur Lehre v. d. Extrauterinschwangerschaft u. dem Orte der Zusammentreffens von Ovulum u. Spermatozoen," "Archiv f. Gyn.," Bd. xxviii, S. 325.

[2] Henle, "Handb. Anat. d. Menschen," 1864, Bd. ii, S. 470; and Bischoff, "Entwickelungsgeschichte," S. 28.

[3] Wyder, *loc. cit.*

A. Second and Third Weeks.



1 2 3 4 5 6

B. Fourth Week.

7 8 9 10 11 12

C. Fifth Week.

13 14 15 16 17

Fig. 68.—Early human embryos, all enlarged about two and a half times: 1–4, From twelfth to fifteenth day; 5, 6, from eighteenth to twenty-first day; 7, 8, from twenty-third to twenty-fifth day; 9–12, from twenty-seventh to thirtieth day; 13–17, from thirty-first to thirty-fourth day. *am*, Amnion; *uv*, umbilical or vitelline vesicle; *als*, allantoic or abdominal stalk; *c*, *c'*, brain vesicles; *h*, heart; *va*, visceral arches; *o*, optic vesicle; *ot*, otic vesicle; *ol*, olfactory pit; *l*, *l'*, upper and lower extremities; *s*, somites; *cd*, caudal process; *u*, primitive umbilical cord (His).

The changes in the ovum immediately before impregnation are described in the preceding chapter. It only remains to notice the successive changes in size and development that determine the age of the ovum and embryo and that explain intra-uterine deformities and diseases.

The youngest human ova seen and described have been eight to thirteen days old.[1] Peters' claim that the ovum in his famous case was only three or four days old is not generally admitted. In this case the diameter of the ovum was about 1 mm.; the chorion is furnished with thin and simple villi, the allantois is not to be detected, and almost the whole ovum is occupied by the yolk-sac.

Waldeyer has described an ovum, twenty-eight to thirty days old, that measured 19 mm. (0.748 in.) in length, 16.5 mm. (0.649 in.) in breadth (about the size of a pigeon's egg), and weighed 2.3 gm. (36 grs.). The length of the embryo, in a straight line from cephalic to caudal extremity, was 8 mm. (0.315 in.), while the actual length of the dorsal line was 20 mm. (0.79 in.).

During the first month the human embryo is indistinguishable from that of other mammals. The ovum at this early period may be described as a double-walled, flattened vesicle, filled with fluid. The outer wall bears the branched villi; the inner one is smooth. The connection of the villi with the decidua reflexa, and even with the decidua serotina, is a superficial one, and the ovum is easily separated from its uterine attachments.[2] The yolk-sac, at first occupying nearly the whole ovum, even at the end of the first month is larger than the cephalic extremity of the embryo. The visceral arches are distinct; the limbs are merely rudimentary; the cord is straight, thick, and short; and the amnion is still quite close to the embryo, and is separated from the chorion by a clear space.

During the first month the heart appears as a cylindrical body, which soon becomes S-shaped, and by the fourth week displays four distinct cavities and is covered by its pericardium. It is probably functionally active by the third week.[3] The brain and spinal cord are inclosed; the intes-

[1] "Edinb. Med. Jour.," vol. lii; "Verhandl. d. Ak. d. W. Amsterdam," iii, 3; "Historie du Dévelop.," pl. iii; "Arch. f. Gyn.," Bd. v, S. 170; "Abhandl. d. Königl. Ak. d. W. zu Berlin"; "Wien. med. Wochen.," 1877, S. 502; "Arch. f. Gyn.," Bd. xii, S. 421; *ibid.*, Bd. xii, S. 482; Peters, "Ueber die Einbettung des Menschlichen Eies," 1899; Leopold, "Centralbl. f. Gyn.," 1896, p. 1057; also "Uterus u. Kind."

[2] See Br. Hicks, "Obst. Tr.," xiv, p. 149; Langhans, "Archiv f. An. u. Phys.," 1877, ii u. iii, S. 231; Ahlfeld, "Arch. f. Gyn.," Bd. xiii, S. 231.

[3] Preyer, "Specielle Physiologie des Embryos."

tinal tract is also closed over, but the connection with the umbilical vesicle is still a wide one; the first traces of a liver appear; the primitive kidneys may be seen; and toward the end of this period the eyes may be distinguished at the sides of the head and the rudimentary extremities become visible as four bud-like processes. The oral and anal orifices of the intestinal tract are formed by depressions in the integuments, which open into the extremities of the tract after the absorption and disappearance of the intervening tissues.

Second Month.—At the beginning of the second month the ovum is the size of a pigeon's egg, and the embryo measures 8 mm. (0.3 inch) in a straight line from head to tail. During this month the embryo grows to 2.5 cm. (1 in.) in length and the ovum reaches the size of a hen's egg. The visceral clefts close, with the exception of the first, which eventually forms the external auditory meatus, the cavity of the tympanum, and the Eustachian tube. The first visceral arch, dividing into two branches, forms the superior and inferior maxillary processes. The latter, one from each side, approach each other and finally unite to form the lower jaw. The superior maxillary processes, while approaching each other, are kept from uniting by the intervention of the frontal process. At the point of junction of the latter with the two superior maxillary processes there occurs occasionally the deformity known as harelip, from the failure of the processes to unite; but as union is always perfect before the end of the second month, the arrest of development that results in this deformity must have taken place at some time prior to the third month. During the second month, from the growth of the viscera, the body becomes less curved, and from the development of the brain the head increases in

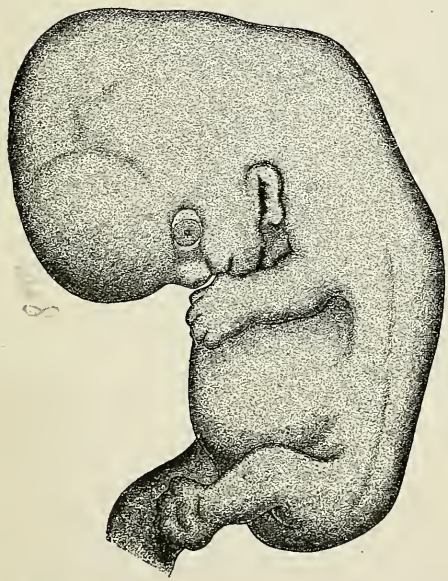


Fig. 69.—Human embryo of about six weeks, enlarged five times (His).

size. The umbilical vesicle atrophies, and may be found attached to the body by a slender pedicle. The umbilical ring is somewhat contracted, but still contains a few loops of intestine; so that if there is at this time an arrest in the development of the abdominal walls, an extensive umbilical hernia or exomphalos results. The umbilical cord runs straight to the periphery of the ovum. The eyes occupy a position on the sides of the head; behind them may be seen the ears, and in front arises the external nose. The limbs are separated into their three divisions, and the first suggestions of hands and feet appear, with the fingers and toes webbed. The Wolffian bodies are much lessened in size, but the kidneys and suprarenal capsules are developed. The external genitals make their appearance, but neither internally nor externally is the sex to be distinguished, for the elements of both sexes are present in equal degree. Toward the end of the second month or at the beginning of the third the eyelids appear. There are points of ossification to be seen in the lower jaw and clavicle. The villi of the chorion have taken on a more luxuriant growth at the point where the future placenta is to be developed, and the fetus draws its nutriment from the maternal blood.

Third Month.—During this month the ovum attains the size of a goose's egg, 9.5 to 11 cm. (3.74 to 4.3 in.) long, and the embryo grows to a length of 7 to 9 cm. (2.75 to 3.5 in.) and weighs about 30 gm. (460 grs.). The umbilical cord increases in length to 7 cm. (2.7 in.) and becomes twisted. The umbilical ring is smaller and the intestines are retracted within the abdomen. The fingers and toes lose their webs, and the nails appear as fine membranes. The eyes approach nearer to each other and are protected by the lids. Points of ossification may be found in most of the bones, and the neck separates the head from the trunk. The ribs divide the trunk plainly into chest and abdomen; the oral and nasal cavities are separated by the palate; the lips close over the mouth and teeth begin to form in the jaws. The sex may be distinguished by the presence or absence of a uterus; cutaneous folds form a scrotum or the labia majora, but the clitoris and penis are still of equal length. The chorion loses its villi, except at the point where the placenta is developing. The latter, though small, can plainly be distinguished.

Fourth Month.—In the fourth month the fetus attains a length of 10 to 17 cm. (4 to 6.75 inches) and a weight of 55 gm. (850 grs.).[1] The umbilical cord is more twisted than in

[1] Given by Spiegelberg as Hecker's weights and measurements. Spiegelberg, "Lehrbuch," tr. by Syd. Soc., p. 118.

the preceding month, and the placenta is increased in size. The head of the fetus now amounts to a quarter of the whole length of the body, and the cranial bones are in part ossified, although the fontanels and sutures gape widely. The sex is plainly seen, the genital fissure, in the case of a male, having united to form the scrotum, leaving in the median line a distinct raphé. The future prostate is indicated by a thickening at the point of meeting of the genital cord and the urethra. A fine growth of down appears upon the fetal skin (lanugo), and a few hairs are seen on the scalp. The intestines contain meconium; the limbs may be feebly moved; and the fetus may live, if born, as long as four hours (Cazeaux).

Fifth Month.—During this month the fetus is about 18 to 27 cm. (7 to 10.5 inches) long and weighs about 273 gm. (8 ounces). The umbilical cord is about 31 cm. (12 inches) long. The liquor amnii exceeds the fetus in weight. The head is relatively very large; the face has a senile look and is wrinkled, and the eyelids begin to open. The skin is richer in fat, is covered with lanugo, and in places with vernix caseosa, a sebaceous material containing also epithelial scales and downy hairs. Some time during the fifth month the mother usually experiences "quickening,"—that is, the movements of the fetus,—and the fetal heart-sounds may be heard on auscultation. If the fetus should be born at this time, it may make efforts to cry, but it dies in a few hours.

Sixth Month.—The fetus toward the end of the sixth month is from 28 to 34 cm. (11 to 13.5 inches) long and weighs 676 gm. (23½ ounces). The skin is better supplied with fat; the hairs of the scalp grow longer; eyebrows and eyelashes are distinct. The umbilical cord is inserted in the middle third, between the pubic symphysis and the xiphoid cartilage. The head is still relatively large. The testicles in boys approach the inguinal rings. If a fetus at this stage should be born, it might live from one to fifteen days, but would, in all probability, eventually die from insufficient assimilation of food, from rapid loss of heat, and from imperfect respiration, owing to the undeveloped state of the finer ramifications of the air-passages.

Seventh Month.—At the end of this month the fetus measures in length 35 to 38 cm. (13.75 to 15 inches) and weighs 1170 gm. (41¼ ounces). The whole body is covered with lanugo except the palms of the hands and the soles of the feet. The large intestine contains a considerable quantity of meconium. The pupillary membrane, which had hitherto obscured the pupil,

now disappears. A child born between the twenty-fourth and twenty-eighth weeks usually dies.[1]

Eighth Month.—The fetus measures in length 39 to 41 cm. (15.25 to 16 inches) and weighs 1571 gm. (3½ pounds). The hair on the scalp is more abundant; the down on the face is disappearing. One of the testicles, usually the left, has descended into the scrotum. The nails are firmer, but do not yet project beyond the finger-tips. At the end of the eighth month ossification begins in the lower epiphysis of the femur. The cord is inserted a little below (0.6 to 1.2 inches) the middle point, between the xiphoid appendix and the pubic symphysis. A child born at this period may, with proper care, survive.

Ninth Month.—The length of the fetus measures 42 to 44 cm. (16.5 to 17.25 inches) and the weight is 1942 gm. (4¼ pounds). There is a decided increase in subcutaneous fat. The nails are not yet perfectly developed. Toward the end of this month, near the thirty-sixth week, the weight is about 5½ pounds, and the diameters of the skull about 1 to 1.5 cm. (0.39 to 0.50 in.) less than in a normal fetus at term.[2] The bones of the skull are compressible and easily molded to the shape of the pelvic cavity; and if born at this time, the infant with ordinary care will certainly live.

Tenth Month.—During the tenth month (thirty-sixth to fortieth week) the fetus is developing from the condition just described—that is, characteristic of the thirty-sixth week—into the infant at term, distinguished by all the features that indicate the arrival of the fetus at maturity. It is during the last month of pregnancy that the physiology of the fetus can be studied to the best advantage. It has now reached a large size and requires a considerable quantity of oxygen[3] for its blood and nourishment

[1] There persists, even yet, in the minds of some general practitioners, as well as among the laity, as the writer can testify, the idea that children born in the seventh month will be more likely to survive than those born at the eighth month. Professor Parvin ("Science and Art of Obstetrics") shows how this superstition has descended, through more than two thousand years, from Hippocrates, who explained that the fetus is placed with its head uppermost in the uterine cavity until the seventh month, when the increasing weight of the head causes it to fall down to the os uteri. As soon as this occurs, the fetus attempts to make its escape, and if it is strong it succeeds, but if the attempt fails, it is repeated at the eighth month, and if the infant now succeeds in escaping from the womb, being exhausted by its previous effort, it is likely to die.

[2] Schroeder, from the measurements of 68 premature infants, gives the average biparietal diameter of the head as 8.83 cm. (3.5 in.) from the thirty-sixth to the fortieth week; 8.69 cm. (3.42 in.) from the thirty-second to the thirty-sixth week; 8.16 cm. (3.21 in.) from the twenty-eighth to the thirty-second week, showing that this diameter, a most important one, is relatively very large even early in fetal life.

[3] That the fetus obtains oxygen from the maternal blood has been proved by (1) cutting off the blood-supply to the uterus, when the fetus will die of asphyxia (Vesal, Seyl); (2) by the discovery, by means of spectral analysis, of oxyhemoglobin in the umbilical vein of the cord (Zweifel).

for its tissues, both of which it obtains from the maternal blood through the medium of the epithelial cells that form the outermost fetal layer of the placenta (the syncytium). From the fact that the fetus undoubtedly swallows considerable quantities of liquor amnii during the latter months, at least, of pregnancy,[1] and because that liquor contains a small proportion of albumin,[2] it has been claimed that the fetus derives its whole nourishment from the amniotic fluid, while the function of the placenta is confined to the oxygenation of the fetal blood,—a theory not likely to find general acceptance. Another fact, however, in its favor is the secretion of the gastric glands during the latter period of intra-uterine life.[3] The urine, secreted in considerable quantity, and, as a rule, albuminous,[4] is voided freely into the amniotic cavity. The fetus, from time to time, moves its limbs vigorously, and its heart beats from one hundred and twenty to one hundred and sixty times a minute.

The circulation of the fetal blood has certain peculiarities that deserve consideration. Beginning at first by a very simple arrangement in a tubular heart and four vessels (two arteries and two veins), which carry the blood to and from the umbilical vesicle, it soon assumes the characteristics that are most plainly to be seen in the stage of pregnancy under consideration. The blood that has been oxygenated in the terminal villi of the placental tufts is returned by veins of increasing size to the large branches of the umbilical vein, which may be seen directly under the amnion on the fetal surface of the placenta. These branches, converging, unite in the umbilical vein, which is carried by the cord to the fetal body at the umbilicus. Thence it runs along the anterior surface of the abdominal cavity to the under surface of the liver, where, giving off branches to the lobus quadratus, lobus Spigelii, and to the left lobe, it divides into two main trunks at the transverse fissure, the larger of which enters the portal vein, while the other empties into the ascending cava and is called the ductus venosus. Thus by far the greatest quantity of oxygenated blood that is returned to the fetus from the placenta must first pass through the liver before entering the general circulation. The ascending cava conveys

[1] Zweifel, "Untersuchungen über das Meconium," "Arch. f. Gyn.," Bd. vii, 1875, p. 474.

[2] Anderson, "Am. Jour. Obstetrics," Aug., 1884.

[3] Krukenberg, "Magensecretion des Fötus," "Centralbl. f. Gyn.," No. 22, 1884.

[4] Ribbert, "Ueber Albuminurie des Neugeboren u. des Fötus," Virchow's Archiv," Bd. xcviii, S. 527.

then to the right auricle a large proportion of arterial blood, but mixed with it is the venous blood from the lower extremities and the blood returned from the liver. But this great volume of blood having arrived at the right auricle, instead of descending into the right ventricle and being carried thence to the lungs, which in their unexpanded condition could not contain it, is guided across the right auricle by the Eustachian valve, and enters the left auricle by means of an opening in the interauricular septum,—the foramen ovale. From the left auricle the blood from the ascending cava enters the left ventricle and is driven thence into the aorta, by which it is conveyed primarily to the upper extremity of the fetus by the ascending branches of the arch of the aorta. Here may be seen an arrangement peculiar to fetal life, by which the blood is diverted from the unused lungs and conveyed instead to the aorta. Just beyond the point at which these branches are given off there opens into the aorta a large branch from the pulmonary artery (the ductus arteriosus), which conveys the blood that enters the right auricle, and then the right ventricle, from the descending vena cava. Only a small quantity of blood, sufficient for their nutrition, goes to the lungs. Thus the aorta conveys a mixed blood, still further devitalized from the infusion of the venous blood from the head, neck, and upper extremities, to the trunk and lower extremities. It is by this arrangement that a greater quantity of arterial blood is conveyed to the brain, which develops so

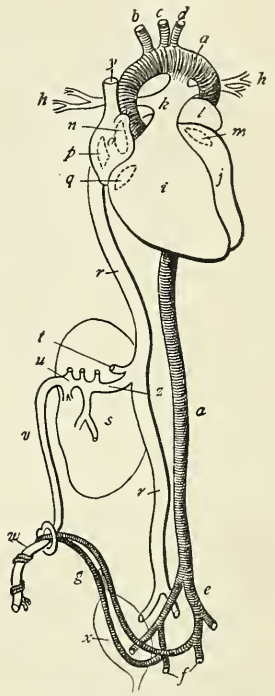


Fig. 70.—Diagram of the fetal circulation: *a*, *a*, Aorta; *b*, innominate artery; *c*, left carotid; *d*, left subclavian; *e*, iliacs; *f*, internal iliac arteries; *g*, hypogastric arteries; *h*, pulmonary artery; *i*, right ventricle; *j*, left ventricle; *k*, ductus arteriosus; *l*, left auricle; *m*, left auriculoventricular opening; *n*, foramen ovale; *o*, right auricle; *p*, Eustachian valve; *q*, right auriculoventricular opening; *r*, vena cava ascendens; *s*, liver; *t*, hepatic vein; *u*, branches of the umbilical vein to the liver; *v*, umbilical vein; *w*, umbilical cord; *x*, bladder; *y*, vena cava descendens; *z*, ductus venosus (Flint).

rapidly during intra-uterine life. Following the blood-current down the aorta to the iliac arteries, and thence to their internal branches, two arteries, one from each branch, ascend to the umbilicus whence they pass out of the body to form the two arteries of the umbilical cord. Within the body they are known as the hypogastric arteries. The two arteries of the cord carry to the placenta vitiated blood, which, in the terminal placental villi, discharges into the maternal blood the effete products of the life-processes in the fetus and receives in return a fresh supply of oxygen and nutriment, and probably a fair share of the soluble salts of the blood, as well as any other substance, medicinal [1] or otherwise, that the maternal blood may contain in solution or possibly even in suspension.

While the passage of matter from the maternal into the fetal blood seems to occur so frequently, it would appear to be more difficult for substances, aside from the effete products of tissue activity, to pass from fetus to mother. There is reason to believe, however, that the poison of syphilis may take this course. It has also been demonstrated that certain drugs, as strychnin, may pass from fetus to mother.[2] The ease with which medicinal substances pass from mother to fetus has caused anxiety lest in the administration of powerful drugs to the mother the fetus might be injuriously affected.[3] It is possible, of course, to harm the fetus by administering poisonous substances to the mother, but it is extremely unlikely that the fetus will be much affected unless the dose to the mother much exceeds the usual therapeutic limit. But, like the adult, the fetus may become accustomed to a drug, and be able finally to endure large quantities of it in the maternal blood.[4]

The temperature of the fetus in utero is slightly higher than that of its mother. Priestley,[5] in experiments on rabbits and cats, found the temperature of the fetus about 1° F.

[1] Chloroform, carbonic oxid gas, salicylate of sodium, benzoate of sodium, atropin, strychnin, morphin, quinin, corrosive sublimate, iodid of potassium, ether, urea, the bile-salts, soluble salts of lead, tobacco, sulphindigolate of soda, the germs of many diseases, have all been known to pass from mother to fetus.

[2] Schroeder, "Geburtshülfe," 8th ed., p. 63.

[3] Parvin's "Obstetrics," 148.

[4] I was obliged on one occasion to administer very large doses of morphin daily for a period of some weeks to a patient who was suffering from general septicemia in the seventh month of pregnancy. The fetus continued to move actively *in utero*, and I could detect no change in the fetal heart-sounds. The woman finally gave birth to a living infant.

[5] "Lumleian Lectures on the Pathology of Intra-uterine Death," rep. for "Brit. Med. Jour.," 1887, p. 16.

higher than that of its mother. Taking the temperature *in ano* of a fetus coming down during labor by the breech, and comparing it with the temperature of the vagina,[1] or taking the temperature of infants immediately after birth,[2] the fetus is found warmer than the mother by 0.5° C.

Of all the organs in the fetal body, the liver is the most active. Almost all the oxygenated blood from the placenta goes first to the liver. The great quantity of meconium in the fetal intestines—a substance composed mainly of bile-salts—attests the active secretory work of this organ, and to it, also, may be attributed the source of the large quantity of glycogen[3] found in fetal tissues, especially the muscles, where this substance probably has work to perform, the nature of which is not yet understood.

THE MATURE FETUS.

There is no single sign that enables one to declare a given fetus to be fully mature; but the weight, measurements, and stage of development, taken together, indicate with tolerable accuracy the length of time that the fetus has remained *in utero*. By the two hundred and eightieth day a healthy fetus should weigh about 3317 to 3459 gm. (7⅓ to 7⅔ pounds), according to the statistics of Lusk and Parvin; but in Europe the weight of the mature fetus is somewhat less, for the statistics of Scanzoni, Ingerslev, Hecker, Fesser, and Bailly, including a very large number of observations, give a weight of less than 3175 gm. (7 pounds). Variations in weight at term between 2728 and 4082 gm. (6 and 9 pounds)[4] are by no means rare, and the range of possibility in the weight of a mature fetus is a very wide one. Thus Harris[5] refers to an infant that weighed but a pound, and to another, the child of the Nova Scotia giantess, that weighed 13040.78 gm. (28¾ pounds) at term. A decided departure,

[1] Wurster, "Berlin. klin. Wochens.," 1869, No. 37, and "Beitr. z. Tocothermometrie," D. i, Zürich, 1870.

[2] See Bärensprung, Müller's "Archiv," 1851; Schäfer, D. i, Greifswald; Andral, "Gaz. Hébd.," July, 1870; Schroeder, Virchow's "Archiv," Bd. xxxv, S. 261; and the "Lehrbuch," 8th ed., 1894, p. 65; also, Alexeeff, "Archiv f. Gyn.," Bd. x, S. 141.

[3] Marchand, "Ueber das Glykogen in einigen fötalen Geweben," Virchow's "Archiv," Bd. c, S. 42.

[4] An infant of over nine pounds is not common, while heavier weights are progressively rare. Out of 1000 infants, Dr. Parvin saw but one that weighed 11 pounds (Parvin's "Obstetrics," p. 138). Of 1156 infants born in my service in the Maternity Hospital, the heaviest weighed 12 pounds.

[5] Note to Playfair's "Midwifery."

however, from the normal average indicates, on the one hand, prematurity or a weak development; on the other, the prolongation of pregnancy, race peculiarities, the vigor or excessive size of the parents, especially the mother, or the preoccurrence of several pregnancies. Sex also influences the size of the infant, males being, on an average, larger than females. The length of a mature fetus is 51 to 53 cm. (20 to 21 in.). The width across the shoulders (binacromial diameter) is about 12 cm. (4.75 in.); the dorsosternal diameter is 9 to 9.5 cm. (3.5 to 3.75 in.); the biniliac, 9.5 to 10 cm. (3.75 to 4 in.). The length of the foot is about 8 cm. (3.15 in.).[1] The dimensions of the head are important as a sign of the development of the fetus.

The following dimensions of the fetal head may be considered characteristic of the normally developed infant directly after its expulsion from the uterus:

Bitemporal (B. T.) diameter, ...	8 cm. (3.15 in.).
Biparietal (B. P.) diameter, ...	9¼ cm. (3.64 in.).
Occipitofrontal (O. F.) diameter, ...	11¾ cm. (4.56 in.).
Occipitomental (O. M.) diameter, ...	13 cm. (5.12 in.).
Maximum (M. M.) diameter, ...	13½ cm. (5.32 in.).
Suboccipitobregmatic (S. O. B.) diameter, .	9½ cm. (3.74 in.).
Trachelobregmatic (T. B.) diameter, . . .	9½ to 10 cm. (3.74 to 3.94 in.).

Circumferences: O. F., 34½ cm. (13.58 in.); S. O. B., 30 (11.8); O. M., 37 (14.5).

These dimensions are subject to modification. Any of the causes that tend to increase the size of the infant as a whole likewise influence the size of the head; but even with a normal body-weight and length the head may be disproportionately large, without being diseased.

Another valuable sign of maturity in the fetus is the appearance and extent of certain centers of ossification.[2] In the center of the lower epiphysis of the femur is found at birth a spot of ossification measuring five millimeters in diameter, while a similar but smaller spot is just appearing in the upper epiphysis of the tibia. The center of ossification in the astragalus is found without difficulty, for it first appears at the seventh month of intra-uterine life. The center of ossification in the cuboid bone is at birth beginning to make its appearance. The ossified spot in the lower epiphysis of the humerus only appears some months after birth.

The general appearance of a new-born infant is of value as indicating whether or not the fetus had reached maturity before its expulsion from the uterus. A healthy infant at term looks

[1] Negri says ("Ann. di Ostet.," May to June, 1885) that when the foot measures eight centimeters the fetus is well developed and weighs about 3500 gm.

[2] See Rossié, "Amer. Jour. of Obstetrics," 1886, p. 18.

stout and well-nourished. The face is plump and is free from lanugo; miliaria are seen about the tip of the nose, but are not nearly so evident as they were in the ninth month of intra-uterine existence. The eyes are usually opened, the limbs move vigorously, and the child seizes with its lips the nipple when presented to it, and sucks with energy. The vernix caseosa is abundant only on the back of the child and on the flexor surface of the limbs. The nails project beyond the finger-tips; the cartilage of the ears and nose feels firm; eyebrows and eyelashes are well developed; the hairs of the scalp are about an inch long; the bones of the head are hard and lie close together. The breasts in both sexes are large, and usually a thin fluid can be squeezed out of them. In boys the testicles are usually to be felt in the scrotum, although the tunica vaginalis is not yet closed. In girls the labia majora are usually approximated, although occasionally the nymphæ project between them.

The Determination of Sex.—In all countries the number of male children born exceeds the number of females, the average proportion being 106 to 100; but, as more boys die than girls, by the time puberty is reached the sexes are about equal in number. The law that governs the production of sex has long been a subject of discussion and speculation. The Hippocratic doctrine that the right ovary produced boys and the left girls was accepted for centuries, and upon this belief was founded the precept that women who desired male offspring should lie during coitus upon the right side, while those who desired daughters must lie upon the left side. By experiments upon animals, by the observation of women in whom one ovary was destroyed by disease or removed by an operation, and by a more complete knowledge of the mechanism of impregnation, the long-accepted teaching of Hippocrates was disproved, although not until comparatively recent times. At present it is undecided whether the question of sex is determined before impregnation occurs,—that is, whether certain spermatic particles or ovules are predestined to produce males, while others produce females; whether the sex is impressed upon the ovule at the moment of conception, or whether the embryo is possessed of the elements of both sexes until one or the other acquires a preponderating influence owing to causes which may be operative during the early part of pregnancy. The first theory receives its chief support from the fact that unioval twins are invariably of the same sex, which looks as though the ovule was predestined in the ovary to the formation of one or the other sex. The last theory is based upon the study of plants and lower animals, in which the sex is only determined at some time after conception by the influence

of nourishment; overfeeding being found to produce females, underfeeding to produce males. It is possible in the case of certain animals to alter the sex, or at least to produce hermaphrodites, even after the sexual organs have begun to be differentiated.[1] This theory is further supported by the fact that in the human embryo the elements of both sexes are always present apparently in equal force during the early part of embryonal life. The belief that the sex of a human embryo is impressed upon it at the moment of conception rests upon the fact that in certain conditions of nutrition or sexual vigor in one or the other parent one sex preponderates, while under opposite conditions the other sex is most frequently produced.[2]

The most diverse conditions have been held accountable for departures from the normal numerical relation of the sexes at birth. Illegitimacy,[3] age of parents,[4] conception at certain periods after menstruation,[5] deformities in the female pelvis,[6] the nutrition or sexual vigor of the parents,[7] the tendency of each sex to produce the opposite or the reverse,[8] the tendency to produce that sex which is most needed to perpetuate the species,[9] the season of the year,[10] climate and altitude,[11]

[1] In the case of the larvæ of bees from impregnated eggs, when the female genital organs have begun to appear, if the nourishment is very insufficient, instead of becoming female workers these animals will actually develop into true hermaphrodites, with the organs of both sexes (Fürst).

[2] Thury ("Zeitsch. f. w. Zoologie," 1863, Bd. xiii, S. 541) found in 29 experiments upon cattle that in every case, if connection occurred at the beginning of heat, females were produced; if at the end, males.

[3] Fürst ("Archiv f. Gyn.," Bd. xxviii, S. 19) says that in illegitimate births the males fall below the average (based upon 807,332 cases). This coincides with my experience in the Maternity Hospital in more than 1000 cases of illegitimate births.

[4] See Hofacker, "Ueber die Eigensch. welche sich von den Eltern auf die Nachk. vererben," 1828; Sadler, "Law of Population," London, 1830; Hecker, "Archiv f. Gyn.," Bd. vii, S. 448; Bidder, "Zeitsch. f. Geburtsh.," Bd. ii, S. 358; Ahlfeld, "Archiv f. Gyn.," Bd. ix, S. 448; Wall, "The Causation of Sex," London "Lancet," 1887, i, pp. 261, 307.

[5] Thury, *loc. cit.*; Coste, "Comptes Rendus," 1865; Schroeder, "Lehrbuch," 8te Aufl., 1884, S. 33; Fürst, "Knaben Ueberschuss nach Conception zur Zeit der postmenstruellen Anämie," "Archiv f. Gyn.," Bd. xxviii, S. 18.

[6] Olshausen, "Klinische Beiträge," Halle, 1884; Linden, "Hat das enge Becken einen Einfluss auf die Entstehung des Geschlechts?" Dis. Inaug., Marburg, 1884; R. Dohrn, "Zeitsch. f. Geburtsh. u. Gyn.," Bd. xiv, S. 80.

[7] See Fürst, *loc. cit.*, and Schroeder, *op. cit.*; S. 33. Also Schenk (Determination of Sex, authorized translation, Chicago, 1898), who believes that imperfect metabolism and glycosuria in the mother predispose to female offspring, while a strong nitrogenous diet and absence of sugar in the urine prepare a woman to bear male offspring.

[8] See Fürst, *loc. cit.*

[9] Düsing, "Die Regulirung des Geschlechtsverhältnisses bei der Vermehrung der Menschen, Thiere, u. Pflanzen," Jena, 1884.

[10] According to Düsing (*loc. cit.*), women impregnated in summer give birth to fewer boys than those impregnated in winter (conclusions based on more than 10,500,000 births).

[11] Ploss found, in Saxony, that up to 2000 feet, the greater the altitude, the larger was the number of male births (at 2000 feet, 107.8 to 100).

diet,[1] and the degeneration of a race, as during the decadence of imperial Rome,[2]—have all been advanced as reasons for apparent excess in the number of male or female births. These theories, however, have been found false or inadequate upon further investigation. An explanation of the determination of sex is not yet obtained, and the production of the sexes at will is still impossible.

Multiple Fetation.—It is the rule that but one fetus at a time is developed within the uterus of a human female. Once in about 120 pregnancies,[3] however, two fetuses are developed simultaneously in the same uterus, so that twins are not of uncommon occurrence. Triplets are found once out of 7900, quadruplets once out of 371,126 births. Quintuplets are extremely rare. There is one case of sextuplets on record.[4] Multiple fetation may be the result: (1) Of the impregnation of a single ovum that contains two or more germinal vesicles, or in which the formative material of the area germinativa divides;[5] (2) of the impregnation of two or more ova which were contained either in one Graafian follicle or in separate follicles, the latter being situated either in one or both ovaries; (3) of the penetration of the ovum by more than one spermatozoön; (4) of the impregnation of ovules escaping at different times from different Graafian follicles (superfetation).[6] There may be a hereditary disposition to multiple fetation. Boer reported, in 1808, an extraordinary example:[7] A woman aged forty had in 11 pregnancies during twenty years given birth to 32 children, to wit: quadruplets twice, triplets six times, twins thrice. The woman herself was one of quadruplets and her mother had had 38 children. Her husband was one of twins, and there was a history of other plural births in his family.

If the multiple fetation is the result of the impregnation of a single ovum, there is but one chorion and one decidua reflexa, although each fetus is inclosed in its own amnion.[8]

[1] J. C. Webster, "Some Fundamental Problems in Obstetrics and Gynecology," "Amer. Med.," Dec. 10, 1904.

[2] Darwin's Collected Works.

[3] According to statistics collected by Veit, based on more than 13,000,000 births, twins occur once in 89 pregnancies; in New York and Philadelphia the proportion is about 1 to 120.

[4] Vassali, "Gaz. Med. Ital. Lombardia," Milano, 1888, No. 38.

[5] Ahlfeld, "Archiv f. Gyn.," Bd. ix, S. 196.

[6] Slavjansky has observed a recent ovulation in a woman three months pregnant, but with extra-uterine pregnancy.

[7] "Wien. med. Wochens.," No. 3, 1897.

[8] Occasionally two fetuses are found in a single amniotic cavity, which is to be explained (1) by the atrophy and absorption of the contiguous amniotic walls; (2) by rupture of the amnion in the latter months from the vigorous movements of the fetus; or (3) by the development of but a single amnion from the very beginning (Myschkin, Virchow's "Archiv," Bd. cviii, S. 133, 146).

In these cases the sex of the fetuses is the same. The placentæ are usually found intimately united when expelled at term, presenting extensive arterial and venous anastomoses—a condition that may give rise to the deformity of one of the twins, known as acardia. But in the early stages of development each placenta, even in unioval twins, is separate. When the embryos are derived each from a separate ovum, there should be separate deciduæ reflexæ, chorions, and placentæ. Occasionally, however, when the ova are implanted close together, the placentæ may be joined, there may be but one decidua reflexa, and it may be difficult to detect the double layer of chorion that should separate the two ova.

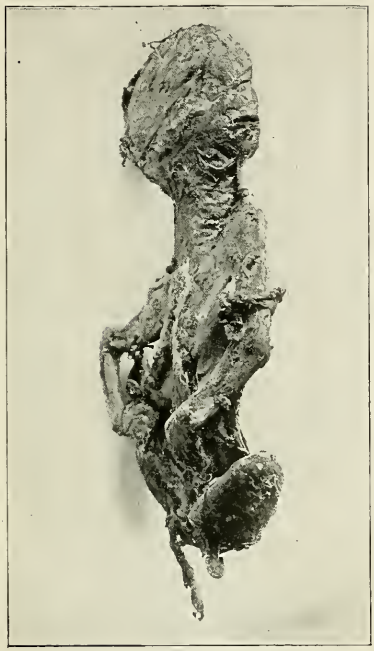


Fig. 71.—Fetus papyraceus (author's specimen).

Although twins are not infrequently born, the condition should be regarded as pathological. From statistics collected by Schatz,[1] it appears that in twins from different ova one is born dead in every twenty-three cases, while from the same ovum the death-rate is one in six. One fetus may outstrip its fellow in growth, and divert the greater part of the nourishment from the mother to itself, thus growing rapidly and encroaching so much upon the room that should belong to the weaker fetus that the latter is killed and finally pressed flat against the uterine wall (fœtus papyraceus). Hydramnios is also very common in twin pregnancies, and occasionally one fetus is converted into an acardiac monster. If the fetuses of a twin pregnancy escape the dangers of intra-uterine life, there are many complications awaiting them in labor. Should one fetus die during pregnancy, it is usually retained until term, when the living and the dead child are cast off together, widely different in appearance and develop-

[1] "Archiv f. Gyn.," Bd. xxix, S. 438.

ment ; [1] or else one ovum may be aborted at an early period of pregnancy, while the other goes on developing until term.[2]

Even though both children have been retained *in utero* an equal length of time, there is usually a marked difference in their length and weight, especially if they have resided in one ovum.[3] In cases of uterus duplex, fetuses of different ages have been found in the two divisions of the uterus. Fordyce Barker reports a case of delivery of two mature children from a woman with a double uterus, one male, the other female, at an interval of two months.[4] Upon such cases, and also upon the fact that of twins in negresses rarely one is light and the other dark, showing probably different paternity, has been based the theory of superfetation ; but as there is no clear proof, as yet, of the occurrence of ovulation during pregnancy, the possibility of the impregnation of ovules which escaped from their Graafian follicles at rather wide intervals of time, say weeks or months, is doubtful.[5]

[1] Schultze, "Volkm. Samml. klin. Vorträge," No. 34.

[2] Sirois, "L'Union médicale du Canada," July, 1887 ; and Warren, "Am Jour. Obstetrics," 1887.

[3] Schatz, *loc. cit.*

[4] See Lusk, *op. cit.*, p. 233, ed. 1886.

[5] For some interesting observations which would seem to indicate the possibility, at least, of ovulation during pregnancy, see "Ovulation During Pregnancy," Christopher, "Am. Jour. Obstetrics," 1886, p. 457.

CHAPTER IV.

The Development, the Anomalies, and the Diseases of the Fetal Appendages: the Membranes, the Placenta, and the Umbilical Cord.

THE study of the development, anomalies, and diseases of the fetal appendages is necessary to a clear understanding of fetal pathology. First will be considered the development and diseases of the fetal appendages springing directly from the embryo—namely, the amnion, the chorion, the allantois, and the placenta; lastly, the deciduæ, the maternal envelope of the fetus.

THE AMNION.

After segmentation has occurred, and after the interior of the ovum has become reduced to a granular mass, around which is a membrane composed of a single layer of cells, at a certain point—the embryonal area—in this membrane there appears a thickening, by a heaping up of the cells. Finally this mass of cells resolves itself into two layers (ecto- and entoderm), and between these two appears another layer of cells (mesoderm).

The outer layer, the ectoderm, sends a prolongation around the whole interior surface of the ovum, and this layer receives a

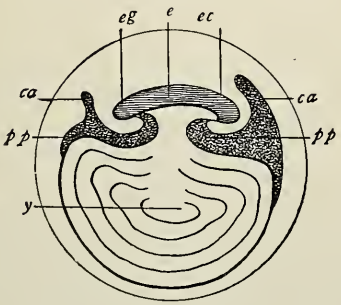


Fig. 72.—*e*, Embryo; *ec*, cephalic extremity; *eg*, caudal extremity; *ca*, *ca*, amniotic hood; *pp*, *pp*, pleuroperitoneal cavity; *y*, umbilical vesicle.

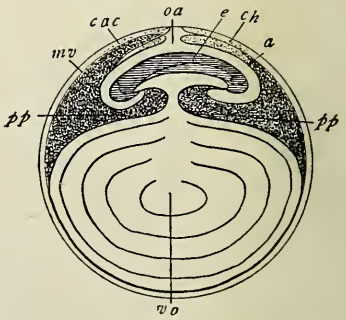


Fig. 73.—*e*, Embryo; *a*, amnion; *oa*, amniotic umbilicus; *cac*, amniochorional cavity; *pp*, *pp*, pleuroperitoneal cavity; *ch*, chorion; *mv*, vitelline membrane; *vo*, umbilical vesicle.

reinforcement from the middle layer of cells, or the mesoderm. It was formerly believed that, as the embryo assumes a definite shape, the lateral walls folding in toward one another, and the caudal extremity approaching the cephalic end of the embryo, the outer layer of cells, forming a membrane continuous with the outer covering of the embryo, instead of being simply carried for-

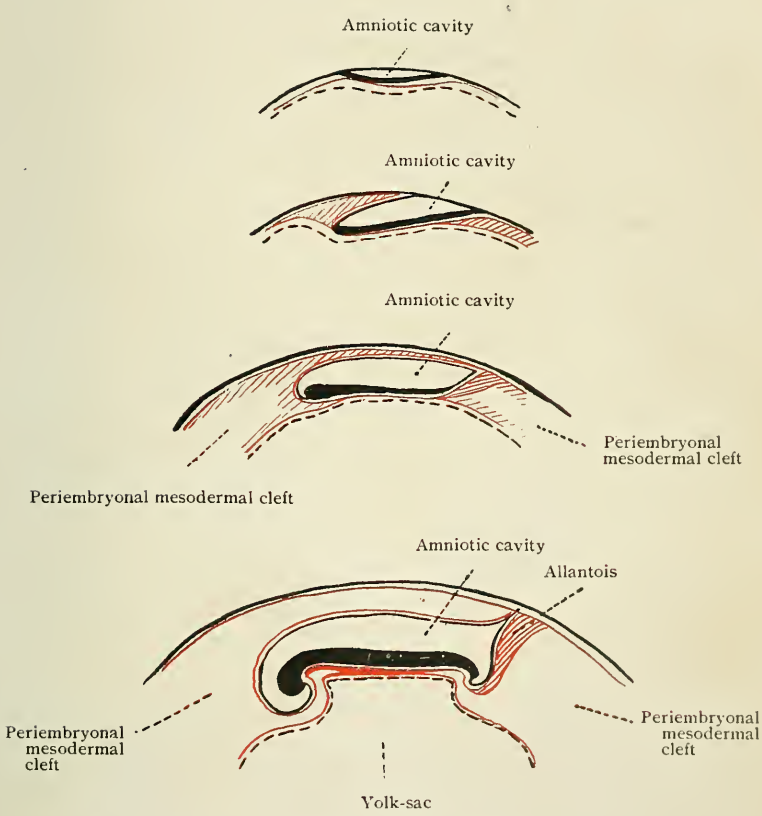


Fig. 74.—Scheme of development of the amnion (Pfannenstiel).

ward to meet in the median line in front, sends reduplications backward over the dorsal aspect of the embryo, which shortly meet and join one another; that there are consequently two cavities formed,—one within the membrane doubled back upon itself; the other between the inner (the true amnion) of the two layers of membrane and the outer covering of the embryo. The

latter is the true amniotic cavity, which is gradually distended by the accumulation of fluid until the membrane containing it is pushed out on all sides, uniting in front around the umbilical cord, and coming in contact throughout the whole extent of the ovum with the outer membrane (true chorion), to which it becomes loosely united by a gelatinous substance,—the tunica media of Bischoff.

This theory is not tenable in view of the observations of Peters and Graf Spee, which demonstrate that the amniotic cavity is closed at a very early date. There must, therefore, be a separation in the cells of the ectoblast constituting a cavity, which as it distends with fluid presses the embryonal area toward the umbilical vesicle or yolk-sac, and folds the amnion around the embryo till the latter is completely enclosed.

The Fully-developed Amnion. — The amnion forms the innermost of the membranes that surround the fetus at term. It is continuous with the fetal epidermis at the umbilicus, forms a complete sheath for the umbilical cord, and covers the fetal surface of the placenta. In its structure it consists of a single layer of flat endothelial cells turned toward the cavity of the amnion, and externally of a layer of young connective tissue, in which may be seen long spindle- or star-shaped cells with long nuclei imbedded in a fibrous substance. The regular disposition of the inner layer of endothelial cells, however, is disturbed at certain points of the amnion lying over the placenta, where numbers of cells are heaped together, forming a little villus-like projection. There are, normally, no blood-vessels in the amnion,—at least, in its later stages of development; their possible occurrence in hydramnios is referred to later.

The Liquor Amnii.—It is the physiological function of the amniotic membrane to furnish a fluid medium (the liquor amnii), which distends the uterine walls and allows the fetus some freedom of movement, and, by its density, approaching the specific gravity of the fetus, robs these movements of much muscular effort. It acts as an additional protection to the fetus from external violence, pressure, and changes of temperature ; it receives the urine secreted in the latter part of fetal life ; and, perhaps, plays a part in the nutrition of the fetus, or at least in supplying the fetal tissues with the excess of water which they possess during intra-uterine life.[1] That the fetus actually swallows considerable quantities of liquor amnii admits of no doubt, for

[1] Preyer, "Physiologie des Embryos."

lanugo and epidermis-scales have been found in the meconium,[1] and also particles of colored matter which had entered the amniotic fluid from the maternal structures (Zuntz). It is not likely that the liquor amnii plays an important part in the nutrition of the fetus, as claimed by von Ott and others; for if it did, the birth of well-nourished children with a breach of continuity in the upper part of the alimentary tract from the mouth to the small intestine would be inexplicable.

The Composition of the Liquor Amnii.—The amniotic fluid is usually almost clear; occasionally, however, opaque, whitish, greenish, or a dark brown from the presence of meconium, or of a reddish color when the fetus is macerated. The specific gravity varies from 1002 to 1028 (Schroeder), being usually about 1007 to 1011. Its reaction is slightly alkaline. It contains salts, urea, carbonate of ammonia, kreatinin, albumin, lanugo, sebaceous matter, epidermis-scales from the fetal skin, and epithelium from the bladder and kidneys. The quantity of the liquor amnii differs at different periods of pregnancy; in the early stages it develops with great rapidity, and at the middle of pregnancy has reached its maximum of about 1 to 1.5 kilograms (2.2 to 3.3 pounds) (Landois). From this time it diminishes in amount, until at the end of pregnancy its average quantity is 680 gm. (1.5 pounds).[2]

The Origin of the Liquor Amnii.—The liquor amnii is derived from both mother and fetus. The maternal origin[3] of the amniotic fluid has been demonstrated by Zuntz, who injected sodium sulphindigolate into the veins of pregnant rabbits, and found a blue coloration of the amniotic fluid, although there was no coloring matter in the kidneys of the fetus. In cases in which the embryo is destroyed very early, moreover, an amount of amniotic fluid may be found corresponding not to the age of the embryo, but to that of the ovum. And it is not unusual to find hydramnios associated with some other serous effusion in the mother.[4]

[1] Zweifel, "Untersuchungen über das Meconium," "Archiv f. Gyn.," Bd. vii, 474.

[2] Fehling, "Archiv f. Gyn.," Bd. xiv, S. 221.

[3] Ahlfeld ("Ueber die Genese des Fruchtwassers," "Archiv f. Gyn.," Bd. xiii, pp. 160–241) gives an ingenious explanation of the manner in which the maternal structures take part in the formation of the liquor amnii: As the uterus develops by an eccentric hypertrophy, the pressure within the uterine cavity becomes less than that of the abdominal cavity, and consequently there is a disposition for the serum of the maternal blood to exude into the amniotic cavity. As Phillips ("Edin. Med. Jour.," March, 1887, p. 811) remarks, however, the case of hydramnios in extra-uterine pregnancy ("Archiv f. Gyn.," Bd. xxii, p. 57), reported by Teuffel, would seem to invalidate this theory.

[4] Pflüger's "Archiv," Bd. xvi, S. 548; and Wiener, "Archiv f. Gyn.," Bd. xvii, S. 24.

The fetus also contributes to the formation of liquor amnii. The excretion of urine during the latter part of fetal life reaches a considerable amount. More than three pints of urine have been found retained in the fetal bladder.[1]

Gusserow[2] injected benzoic acid into the mother, and recovered it as hippuric acid in the liquor amnii,—proof that it had passed through the kidneys of the fetus. Wiener found sodium sulphindigolate in the fetal kidneys and bladder after it had been injected into the maternal tissues. The constant presence of urea[3] in the amniotic fluid after the sixth week is additional proof of the renal activity of the fetus. It is probable also that the vasa propria, discovered by Jungbluth,[4] lying close under the amnion in the early life of the embryo, have something to do with the production of the amniotic fluid. Prochownik[5] claimed that the skin of the fetus secretes amniotic fluid during the early months of gestation. There have been cases of hydramnios associated with morbid conditions of the skin, notably one instance observed by Budin,[6] in which the skin of the fetus was the seat of extensive nevi. Thus it appears that the amniotic fluid is derived from a fetal as well as a maternal source, but the relative importance of the fetal and maternal supply of liquor amnii at different periods of pregnancy is still undetermined.

Abnormalities of the Amnion.—There is a striking similarity between the pathology of the amnion and that of other serous membranes. There is the same liability to changes of secretion, to inflammation with a plastic exudate, and to the formation of bands of adhesion. The function of the amnion, however, and its close relation to the embryo and fetus, give rise, in case of disease, to symptoms and results peculiar to itself.

Abnormalities of Secretion: Oligohydramnios.—Occasionally the quantity of fluid is so deficient as to seriously interfere with the growth of the fetus and to determine its premature expulsion.[7] Schatz[8] reports a case in which there were ulcers on the inner surface of the knees and malleoli of a fetus from constant friction due to a deficient quantity of liquor amnii, and many curious deformities of the fetus may be traced to the same

[1] Lefour, "Archives de Tocol.," June 30, 1887.

[2] "Archiv f. Gyn.," Bd. xiii, S. 56.

[3] Prochownik, "Archiv f. Gyn.," Bd. xi, S. 304–561.

[4] "Beitr. zur Lehre v. Fruchtwasser," Inaug. Dissert., Bonn, 1869; Virchow's "Archiv," Bd. xlviii, S. 523; "Archiv f. Gyn.," Bd. iv, S. 534.

[5] *Loc. cit.*

[6] Tarnier et Budin, *loc. cit.*, p. 279.

[7] "London Lancet," 1886, ii, p. 383.

[8] "Archiv f. Gyn.," Bd. xix, S. 329.

cause.[1] This condition is called oligohydramnios. More frequently the quantity of the liquor amnii becomes abnormally increased—a condition known as polyhydramnion, hydroamnion, dropsy of the amnion, or, more commonly, hydramnios.

Hydramnios.—It has been already stated that the normal quantity of liquor amnii at the end of pregnancy is from one to two pints. Should this quantity be much exceeded, the condition of hydramnios exists. A slight excess is frequent, but usually passes unnoticed, while an accumulation of fluid amounting to two quarts or more is not common. It is difficult, therefore, to express the relative frequency of hydramnios. Charpentier states that it occurs in 1 in 100 or 1 in 150 pregnancies, —an estimate too low for the minor grades of the affection, but too high for cases in which the accumulation of fluid is large enough to give rise to well-marked symptoms. In the majority of cases the fluid collects gradually, but steadily, until at the end of the pregnancy it may reach the enormous quantity of six gallons or more.[2] Occasionally the fluid accumulates very rapidly, giving rise, from the sudden distention of the uterus, to symptoms of a grave character. The rapid accumulation is known as acute hydramnios.

The Etiology of Hydramnios.—It may be due to (*A*) an oversecretion of liquor amnii or to (*B*) a deficient absorption of the liquor amnii.

A. The excessive collection of fluid may be derived from (I) a maternal source, (II) a fetal source, or (III) both fetus and mother may contribute to its production.

I. *The Maternal Origin.*—It is probable that the serum of the maternal blood occasionally exudes in abnormally large quantities into the amniotic cavity. In cases of hydramnios associated with serous effusions elsewhere in the mother's body the excess of liquor amnii is probably derived from a maternal source. Fehling[3] asserts that "the thinner the maternal blood, the greater is the quantity of liquor amnii." A lymphagogue has been found in the liquor amnii of hydramnios, which is not present in the normal liquid. It has been claimed, therefore, that this substance stimulates a serous exudate from the maternal blood.[4]

II. *The Hydramnios May Originate Entirely from Fetal Structures.*—This supposition explains by far the larger number

[1] See "Tarnier et Budin," p. 294.

[2] Wilson, "Am. Jour. Obstetrics," Jan., 1887, p. 22.

[3] "Archiv f. Gyn.," Bd. xxviii, S. 454.

[4] E. Opitz, "Centralbl. f. Gyn.," No. 21, 1898.

of cases that admit of an explanation at all, for hydramnios often occurs (forty-four per cent. of all cases (Bar)) without a demonstrable cause in either mother or fetus. The production of hydramnios, traced to the fetus, may be due: (*a*) To abnormal pressure in the blood-vessels of the cord, or of those directly under the amnion, where it covers the placenta (persistence of the vasa propria of Jungbluth); (*b*) to an excessive urinary secretion; (*c*) to an abnormally profuse excretion from the fetal skin.

(*a*) The vasa propria of Jungbluth, normally present in the early stage of embryonal development, have been found at term in cases of hydramnios,[1] and the production of an excessive quantity of liquor amnii has been attributed to their persistence. It is more probable, however, that the existence of these vessels is purely secondary, and that, although the serum of the fetal blood does exude from them into the amniotic cavity, their presence is due to an increased blood-pressure in the umbilical vein.[2] Increased internal pressure within the umbilical vein causes a transudation through the amnion, as has been proved by Salinger,[3] who found that the amount of fluid which would transude depended upon the strength of the pressure and the size of the cord. Any condition of the fetus, therefore, which raises the blood-pressure in the umbilical vein, thus increasing the blood-pressure in the placenta, may give rise to hydramnios. This happens, for example, in cirrhotic livers common in syphilitic children. There are many other conditions having the same effect—a cord abnormally twisted, velamentous insertion of the cord (exposing the vein to external pressure), stenosis of the umbilical vein, obstruction of the ductus Botalli,[4] tumors of the placenta, tumors of the fetus (interfering with its circulation), valvular defects of the heart,[5] etc.

(*b*) Excessive excretion of urine is a cause of hydramnios. The action of the fetal kidneys in the production of hydramnios can best be demonstrated in cases of unioval twins,[6] in one of which it is common to find a dropsical amnion, while the other one presents usually the opposite condition, oligohydramnios.

[1] Levison, "Archiv f. Gyn.," Bd. ix, S. 517; Lebedjew, "Traité prat. des Acc.," Charpentier, 1883, pp. 886, 890.

[2] Winckler denies the existence of a capillary system of blood-vessels under the amnion, and attributes hydramnios to the presence of a capillary lymphatic system in the cell-layer of the chorion.

[3] "Ueber Hydramn. in Zusamm. mit der Entstehung des Fruchtw.," D. i. Zürich, 1875.

[4] Nieberding, "Zur Genese des Hydramnios," "Archiv f. Gyn.," Bd. xx, S. 275.

[5] Cordell, "Tr. Med. and Chirurg. Fac. Maryland," 1888, p. 218.

[6] Schatz, "Archiv f. Gyn.," Bd. xix, S. 329; Werth, *ibid.*, xx, 353; Sallinger, *loc. cit.*

The history of these cases is that one fetus outstrips the other in growth, and thus, acquiring a preponderating influence in the placenta which is common to both, its heart takes on a hypertrophy to enable it to carry on the greater part of the placental circulation. The hypertrophied heart produces in its turn hypertrophy of the kidneys and determines their increased secretion. The increased blood-pressure also determines an increased activity of the excretion from the skin, and thus in a twofold manner helps to increase the quantity of liquor amnii.

(*c*) The fetal skin is a source of hydramnios. It can readily be understood that an increased blood-supply from a hypertrophied heart can stimulate the fetal skin to overaction. There are, however, more direct proofs of the part that the skin may play in the production of hydramnios. Budin [1] has described a case of hydramnios associated with extensive nevi, and another in which the skin was thickened and thrown into folds. Steinwirker [2] has recorded a case of hydramnios with "elephantiasis congenita cystica."

Finally, it is not improbable that the amnion itself may take an active part in the overproduction of liquor amnii; that, in other words, the amnion may be affected by acute inflammation (amniotitis), followed by an increased serous exudation. This supposition would explain the cases in which a blow or kick [3] on the abdomen of a pregnant woman is followed by the development of hydramnios and the formation of adhesions between the fetus and the amnion. To amniotitis has been attributed the development of acute hydramnios. Werth's [4] theory also deserves some consideration before leaving the study of the fetal origin of hydramnios. This author believes that a hypertrophied placenta may absorb more fluid from the maternal blood than is required for the fetal economy; that the struggle to get rid of this excess of fluid brings about the hypertrophy of the heart and kidneys to which reference has already been made as occurring especially in one of unioval twins.

III. *Both Fetus and Mother May Contribute to the Production of an Excess of Liquor Amnii.*—This proposition has already been demonstrated in showing the possible derivation of the liquor amnii from both mother and fetus. The cause of the hydramnios, however, is most frequently found in the fetus, while the combined action of both mother and fetus in a single case is rare, but may occur, as in certain cases of syphilis, in which have been found dropsy of the mother and of the fetus associated with hydramnios.[5]

[1] *Loc. cit.* [2] *Loc. cit.*

[3] "Tr. Obstet. Soc. of Baltimore," meeting Feb. 9, 1887. [4] Werth. *loc. cit.*

[5] Meissner and Hufeland, quoted by Wilson, "Am. Jour. Obstetrics," 1887, p. 13.

B. Hydramnios may be due to a deficient absorption of liquor amnii. The production of liquor amnii being normal, but its absorption deficient, hydramnios results. Thus are explained the cases of hydramnios associated with nephritis and serous effusions in the mother.

It has been proved that the fetus swallows liquor amnii in considerable quantities, and it is possible that the skin absorbs some of it. Whether the cessation of these two functions results in hydramnios is uncertain.

Symptoms and Diagnosis.—The symptoms of hydramnios are like those of other cystic tumors in the abdomen. There is, in addition, the history of pregnancy; the tumor may usually be

Fig. 75.—Abdominal distention due to hydramnios. Woman pregnant six months with twins; one sac contained 2⅝ gals.; the other, one pint (author's case).

defined as the uterus, very much larger than it should be at the date that pregnancy has reached; and, except in extreme cases, it is possible to detect the fetal heart-sounds, or to practice ballottement. As the uterus distends it gives rise, by its increased size, to pressure symptoms in the abdomen and thorax, although it is astonishing how large it grows without seriously inconveniencing the patient. But this is not the case when the liquid is rapidly effused, as in acute hydramnios.[1] The woman suffers intense pain from the sudden distention of the uterus. Her breathing becomes labored, and complete orthopnea is developed; her face is cyanosed and bears an

[1] Acute hydramnios is rare: of 623 cases of hydramnios in the Baudelocque Clinic, only 8 were acute (Dion, "Thèse de Paris," 1896).

anxious expression; constant and distressing vomiting appears, and there is fever.[1] The detection of hydramnios is not always easy, and may be practically impossible. It may be confused with pregnancy associated with ascites, or with a cystic tumor of the ovary or broad ligament, or with an ordinary twin pregnancy; or the fact that the woman is pregnant may be entirely overlooked. This mistake has frequently led to the tapping of the pregnant womb,[2] which appears to be harmless. It is possible to mistake the overdistended bladder associated with a retroflexed gravid uterus for hydramnios. When the dropsy of the amnion has not reached an excessive degree, the distinction between it and ascites with pregnancy may be made by mapping out the uterine wall and detecting resonance along the flanks in the dorsal decubitus; and an ovarian cyst in pregnancy may be excluded by the absence of two tumors of different consistency and shape. A twin pregnancy without hydramnios presents, on external palpation, an enlarged uterus, offering firm but irregular resistance from its solid contents. In extreme distention of the uterus, which in some cases seems limited only by the utmost capacity of the abdomen, a definite diagnosis is impossible; in such cases it is justifiable to resort to an exploratory puncture of the membranes through the cervical canal, or even to an abdominal section.[3]

Treatment.—If the fluid accumulates in such quantity or so rapidly as to produce alarming symptoms in the woman, its evacuation is indicated. This is best accomplished by rupturing the membranes through the cervix and allowing the liquor amnii to escape. By this method labor is induced, and if the child is not viable, its destruction is a necessary consequence. Moreover, the sudden gush of liquor amnii from the uterus may induce syncope by the rapid reduction of intra-abdominal pressure, or may result in excessive tympany from the sudden relief of pressure on the intestines. It has, therefore, been proposed (Guillemet, Schatz) that the uterus be tapped through the abdominal wall, and a moderate quantity of liquor amnii be removed from time to time, thus preserving the life of the fetus. But the fetus in hydramnios is often deformed or diseased, and usually dies shortly after birth; its life, therefore, deserves little consideration in comparison with the additional risk entailed upon the mother by puncturing the abdominal and

[1] See Charpentier, "Traité Pratique des Accouchements."

[2] Cases reported by Scarpa, Camper, Noël, Desmarais, Schatz, Tillaud, Chiara, Kidd, and others, not followed by the slightest bad results.

[3] Successfully performed in a case of extreme distention of the abdomen from hydramnios by Wilson, *loc. cit.*

uterine walls. It is especially in acute hydramnios that rupture of the membranes is called for, irrespective of the age or condition of the fetus.

Special instruments have been devised for the perforation of the membranes, and it has been suggested that the puncture be made at a point far within the uterine cavity, and thus removed from the external os, so that the liquor amnii may trickle slowly down between the membranes and the uterine wall, and the disadvantages of a sudden escape of the fluid be thus avoided. The author usually employs an Emmet curet forceps or a Thomas' applicator forceps to rupture the membranes.

Abnormalities of the Liquor Amnii in Color, Consistency, and Chemical Constitution.—The liquor amnii, which is normally somewhat opaque and whitish in color in the last months of pregnancy, may be green or brown from the presence of meconium, or it may be tinged with red if the fetus is macerated. The consistency of the fluid in extreme cases of oligohydramnios is that of thick syrup or of mucus. It may contain sugar if the mother has diabetes mellitus.[1]

Putrefaction of the Liquor Amnii.—Decomposition of the liquor amnii is most likely to be associated with death and putrefaction of the fetus, but an intensely putrid odor of the fluid, with physometra, has been noted with a living child.

Adhesive Inflammation and the Formation of Amniotic Bands.—Early in embryonal life, in case the amnion is not lifted away from the newly-forming skin of the embryo, owing to an insufficient secretion of amniotic fluid or as a consequence of inflammation, adhesions may form between the skin and amnion, and as the amniotic cavity is distended, the adhesive material is stretched, so that it finally forms bands of varying length and thickness, either connecting the fetus with the amnion or with one or both ends detached, floating free in the liquor amnii. The composition of these bands closely resembles that of the plastic material thrown out in inflammations of the serous membranes generally. They are not provided with blood-vessels. The exudation of this plastic material from the amnion results occasionally in the formation of extensive adhesions between the fetus and the amnion, giving rise to grave deformities, as eventration or anencephalus, by preventing the proper arching over of the walls of the body-cavities. The formation of adhesive bands is sometimes followed by intra-uterine amputations. A developing limb may be caught between two of these bands, and as it grows may

[1] Ludwig, "Centralbl. f. Gyn.," No. 11, 1895.

be so constricted that the distal portion of the limb is entirely cut off from its blood-supply. Adhesions may also be formed between various portions of the body and the amniotic covering of the placenta, or the umbilical cord may be artificially shortened by the adhesions of coils one to another and to the fetal skin.[1]

Fig. 76.—Amniotic bands: *h*, Adhesive bands; *d*, *e*, feet; *f*, *g*, genitalia and anus.

In the latter part of pregnancy the amnion may burst, the integrity of the ovum being preserved by the chorion.[2] The fetus then, by its active movements, may roll the amnion into cords, which may become so entangled with the umbilical cord as to constrict it sufficiently to obliterate its blood-vessels.

Cysts of the Amnion.—Cases of cystic formations in the substance of the amnion have been reported by Ahlfeld, Winckel, and Budin.[3] They are small and have no clinical significance. After the death of the fetus the amnion undergoes certain changes, resulting in a loss of its glistening surface and in a considerable thickening. The histology of this change is not yet described.

[1] Leopold, "Ein Fotus mit Verklebungen der Nabelschnur," etc., "Archiv f. Gyn.," Bd. xi, 383.

[2] Schroeder, "Lehrbuch," 8th ed., p. 455. Maroger, "Thèse de Paris," 1904.

[3] Tarnier et Budin, *loc cit.*, p. 274.

THE CHORION.

When the ovule first enters the uterine cavity and imbeds itself in the thickened uterine mucous membrane, the protoplasmic cell-wall of the ovum sends out numerous prolongations, which burrow into the connective tissue of the decidua, fix the egg in its position, and draw nutriment for the whole ovum from the blood-vessels of the uterine mucous membrane. This cell-wall, with

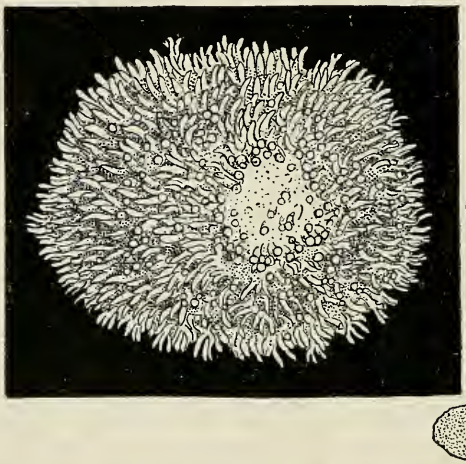


Fig. 77.—A young ovum: *a*, Natural size; *b*, magnified, showing chorionic villi (author's specimen).

its villus-like projections, constitutes the false chorion, which soon disappears and is replaced by the layer of cells springing from the outer layer of the blastodermic membrane and surrounding the whole ovum (the trophoblast). This membrane, in its turn, sends out branch-like processes (the villi of the chorion), which, at first non-vascular but hollow, soon receive into the interior of each branch of the villi loops of the blood-vessels that have been carried from the fetus to the periphery of the egg by the allantois.

These vascular villi absorb nutriment from the whole extent of the decidua reflexa until the third month, when they atrophy and finally disappear, except at that portion of the periphery of the ovum which is in direct contact with the decidua vera (decidua serotina), where the chorion villi develop still further to form the placenta.

The Fully-developed Chorion.—Restricting the term chorion to that portion of the original membrane which undergoes atrophy at the third month of pregnancy, it is found to consist of a thin, transparent membrane made up of connective-

tissue elements continuous with the substance of the umbilical cord and very delicate, atrophied villi connecting it with the decidua reflexa. This portion of the chorion is called chorion læve to distinguish it from the chorion frondosum that forms the placenta. The fibrous membrane, constituting what is usually called chorion at term, is derived from the endochorion, so named to distinguish it from the outer epithelial layer (the exochorion), which is to be found persisting in the epithelial covering of the placental villi.

Fig. 78.—Human embryo at the third week, showing villi covering the entire chorion (Haeckel).

Diseases of the Chorion.—An abnormal condition of the chorion is the persistence of the chorionic villi around the whole periphery of the ovum, thus completely enveloping the fetus by the placenta (placenta membranacea).[1] The degenerations, aside from the normal process of atrophy, that may affect the chorion villi are of two kinds,—cystic and fibromyxomatous.

Cystic degeneration of the chorion villi is characterized by the hypertrophy of the chorion villi, and their conversion into cysts varying in size from that of a millet-seed to the size of a grape or even of a hen's egg, connected with one another and with the base of the chorion by pedicles of varying breadth. It is further distinguished by the rapid growth of the ovum and the consequent expansion of the uterus, usually at the third to the fourth month; by the escape of blood from the uterine cavity into the vagina, and by the premature expulsion of the ovum, which is more or less covered with numbers of small, transparent cysts. Within the cavity of the ovum may or may not be found an embryo.

This affection of the chorion, from the peculiar appearance of the ovum, has attracted much attention, from the time of Ætius von Ameda in the sixth century, and, from the mystery that formerly surrounded its origin and the difference of opinion that existed as to its etiology and minute anatomy, cystic degeneration of the chorion villi, otherwise known as hydatidiform mole, or dropsy of the chorion villi, has been the subject of much discussion. First definitely described by Schenk, the most extraordinary theories have been advanced to account for

[1] See "Amer. Jour. Obstetrics," 1886, p. 851.

its occurrence.[1] Regnier de Graaf (1678) thought that each vesicle or little cyst was an unfecundated ovule. The belief had once prevailed that each vesicle was a living embryo.[2] The opinion of Ruysch (1691) and Albinus (1754), that the existence of innumerable little cysts in the uterus and their final expulsion were dependent upon some disease or alteration of the ovule, was at last generally adopted. A more definite explanation was not attempted until, in the early part of the nineteenth century, it was claimed by Percy,[3] Cloquet,[4] and Mme. Boivin [5] that the vesicular disease was due to echinococci. Velpeau [6] was the first to indicate that the cysts were nothing but distended chorion villi. Since Velpeau's announcement, cystic degeneration of the villi has been attributed to hypertrophy and edema (Meckel, Gierse); to disease of the blood-vessels (Bartolin, Miller, Cruveilhier); to disease of the lymphatics (Bidlos, Sömmerring); to degeneration of the mucous substance within the villi, continuous with the substance of the cord (Virchow); to a degeneration of the epithelial cells derived from the decidua, which replace the epithelial covering (exochorion) of the chorion (Ercolani); to hypersecretion of mucus by the cells of Langhans' layer (von Franqué); to increased blood pressure in the fetal circulation (Gottschalk); and to a pathological hyperplasia of the syncytium, with liquefaction of the epithelial cells in the interior of the villi (Sfameni). A frequent association of the disease with multiple corpus luteum cysts in the ovary, an overproduction of lutein cells and their infiltration of the ovarian stroma, has been demonstrated.[7] A causative relation between the ovarian disease and the degeneration of the chorion has consequently been suspected. But the same lutein cell hyperplasia has been found in normal gravidæ and puerperæ and has been missed in cases of vesicular chorion.[8] Virchow's[9] explanation is that the change resulting in the cystic

[1] See "Tarnier et Budin," p. 299.

[2] See the interesting quotation by Priestley (*loc. cit.*, p. 36) from Ambroise Paré, that "the Countess Margaret brought forth at one birth 365 infants, whereof 182 were said to be males, as many females, and the odd one a hermaphrodite" (1276 A. D.). Pepys records in his diary that he visited the house in which this remarkable delivery occurred and saw the brass platters on which the children were carried before the bishop of the diocese for baptism.

[3] "Jour. de Méd.," t. xxii, p. 171, 1811.

[4] No. 1, "De la Faune des Méd.," Priestley.

[5] "Nouvelles Recherches sur le Môle vésiculaire," broch., Paris, 1827.

[6] "De l'Art des Accouchements."

[7] Ludwig Pick, "Centralbl. für Gyn.," No. 34, 1903; Jaffé, "Arch. f. Gyn.," Bd. 70, H. 3; Scharlieb, "Centralbl. f. Gyn.," No. 49, 1903; Stoeckel, "Beitr. z. Geb. u. Gyn.," Festschrift, 1903. Patellani, "Annal. di Ostet. e Gin.," 4 and 5, 1904.

[8] Wallart, "Ztschr. f. Geburts. u. Gyn.," Bd. liii, No. 1, 1905.

[9] "Die krankhaften Geschwülste," Bd. i, S. 405.

degeneration of the chorion villi takes place altogether in the endochorion, which forms the inner of the two layers that compose the chorion and is continuous with the Wharton jelly of the umbilical cord; this change consists of the overproduction of true mucous tissue within the villi, into which the mucous tissue extends at first alone, but afterward accompanied by blood-vessels. The process usually begins at a time when the villi are almost equally developed over the whole ovum, that is, before the third month,—and, therefore, when the vesicular chorion is expelled the disease is usually found equally distributed over the whole surface, showing no evidence of special develop-

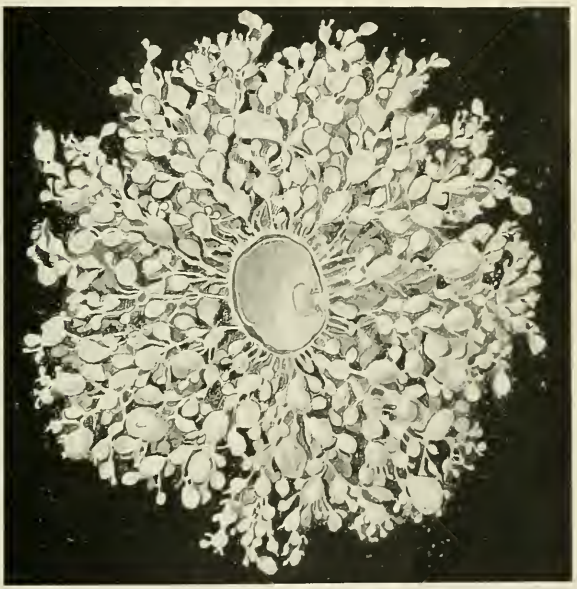


Fig. 79.—Cystic degeneration of the chorion villi (Bumm).

ment at any one point to indicate where the placenta would have been situated. Involvement of the whole chorion is the rule, but exceptionally the placenta alone is affected, the disease having begun after the atrophy of the villi over the extra-placental portion of the chorion. Still more rarely the disease is found in isolated spots upon the chorion lævc.[1] There are recorded cases in which one chorion of a twin conception was vesicular while the other remained normal. According to the

[1] Winogradow, Virchow's "Archiv," 1870, Bd. li, S. 146.

foregoing explanation, the disease is a true myxoma of the chorion, and the epithelial cells (exochorion) covering the villi do not necessarily take part in the morbid process, but the cells of Langhans' layer and of the syncytium display an exuberant growth and a decided inclination to penetrate uterine tissue.

Pathological Anatomy. — The appearance of a vesicular mole is peculiar. The mass may be as large as a man's head, covered more or less completely with decidua, which, upon incision, or in spots where the decidual covering is absent, reveals innumerable small cysts, some as large as grapes, or even as hens' eggs, connected with each other or with the base of

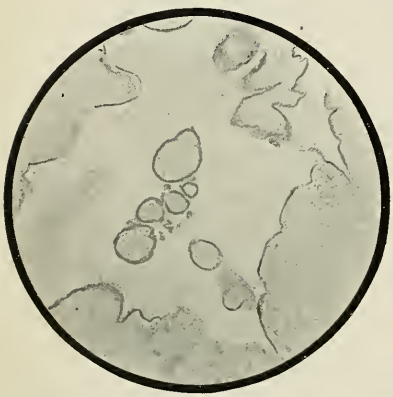


Fig. 80.—Hydatidiform mole (McConnell and J. C. Hirst).

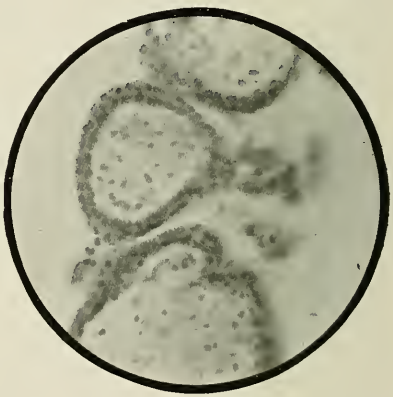


Fig. 81.—Hydatidiform mole, high power, showing two layers of cells (McConnell and J. C. Hirst).

the chorion by pedicles of varying thickness. The liquid in the cysts is usually clear and translucent. A microscopic examination of a section through a villus in the early stages of cystic degeneration shows the distended cells of which Priestley speaks, or else there may be seen the outer cellular and inner fibrous wall of a villus, while within the interior are stellate connective-tissue cells, in the interstices between which may be found mucous tissue.

The fluid in the cysts contains mucin and albumin in considerable quantities.

Within the center of the vesicular mass is usually found a shriveled or distorted fetus surrounded by its amnion, which may contain an abnormal quantity of fluid (hydramnios). Occasionally, no trace of the embryo is discovered, or at most there

may be seen only the remnant of an umbilical cord. More rarely the fetus, although dead, is apparently well developed for the date of pregnancy,[1] and if the degeneration of the chorion has not been too extensive, a living, healthy infant may be born

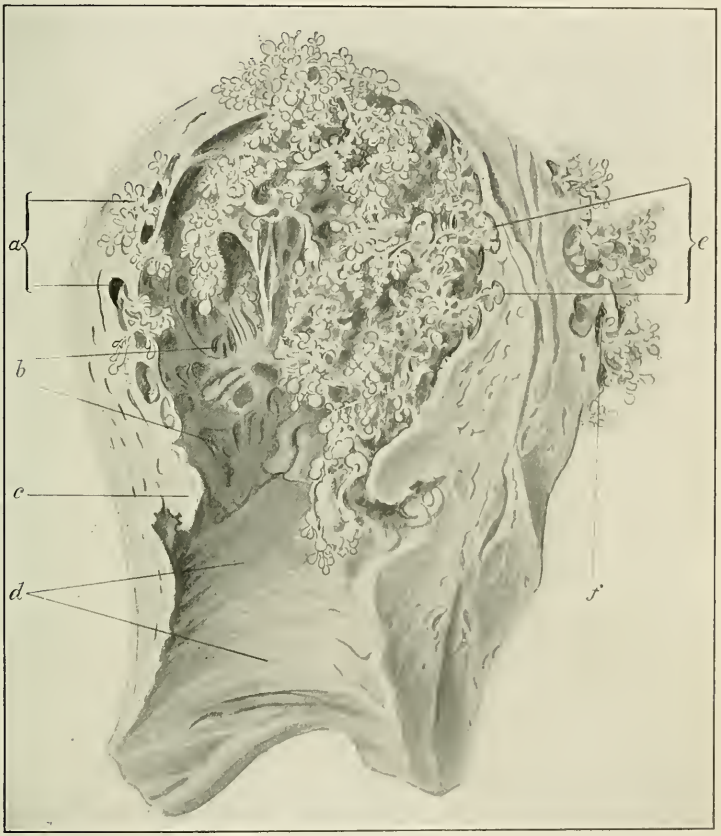


Fig. 82.—Uterus with perforating hydatidiform mole. *a*, Uterine veins and chorion villi; *b*, vessels of the decidua serotina; *c*, internal os; *d*, cervix; *e*, eroded portions of the uterine wall; *f*, uterine veins and degenerated chorion villi. (Bumm.)

with a vesicular chorion.[2] It has been stated that between the amnion and chorion is found a thin layer of jelly-like substance continuous with the Wharton's jelly of the umbilical cord. There is a case on record[3] in which this substance formed a

[1] Priestley, *loc. cit.*, p. 42.

[2] Schroeder, "Lehrbuch d. Geb.," 8th ed., p. 442; and Sym, "Edin. Med. Jour.," Aug., 1887, p. 102.

[3] "Wiener med. Presse," 1867, Bd. i; and Virchow's "Archiv," Bd. xxxix, S. 1.

layer four or five millimeters thick, originating from a mucous degeneration of the connective-tissue layer of the chorion, without involvement of the villi of either the chorion læve or frondosum, thus constituting a peculiar, and to the present time unique, variety of myxoma of the chorion.

The relation of the cystic chorion to the two deciduæ is often abnormal. Occasionally the membranes retain their normal relative position of external deciduæ, median chorion, and internal amnion; but frequently the enlarged villi of the chorion perforate either one or both deciduæ over surfaces of varying extent. Thus, specimens have been described[1] in which the cystic mass was inclosed between the decidua vera and the reflexa, or in which the villi have perforated not only both deciduæ, but also the muscular wall of the uterus, and even its peritoneal covering.[2] The relation of myxoma of the chorion to syncytial cancers is quite intimate. In a large proportion of the latter growths there is associated a cystic disease of the chorion villi. Findlay's statistics[3] of 250 cases of the disease show a development of chorion-epithelioma in 16 per cent. The cases formerly reported of malignant degeneration of the chorion were unquestionably of this character. There may be a metastasis of whole chorion villi, without a malignant degeneration of the epithelial cells,[4] or the chorion epithelium may undergo malignant degeneration after metastasis.[5]

Clinical History and Diagnosis.—There are three prominent symptoms associated with the cystic degeneration of the chorion: (1) Rapid increase in the size of the uterus; (2) discharge of blood or bloody serum, and (3) the escape of vesicles. The last symptom is of rare occurrence, and the first two do not always manifest themselves in a typical manner, so that the clinical phenomena in a case of vesicular mole do not always permit of a definite diagnosis. If there is an escape of blood at intervals during the early part of pregnancy, if the uterus rapidly enlarges toward the third month, and if careful palpation elicits no sign of the presence of a fetus within the uterine cavity, the existence of a cystic chorion may be suspected. If, as rarely happens, characteristic cysts are expelled, there can be no doubt as to the nature of the case. The sudden distention

[1] Priestley, *loc. cit.*, p. 40.

[2] Cory, quoted by Priestley, p. 41. Volkmann, Waldeyer, Jarotzky, Kriegei, Wilton, quoted by Schroeder, *op. cit.*, p. 444.

[3] "Am. Journ. Med. Sci.," March, 1903.

[4] Gaylord, "Tr. of the Gyn. Section, College of Physicians of Phila.," 1898.

[5] Zagorjanski-Kissel, "Ueber das primäre Chorioepitheliom ausserhalb des Bereiches der Ei-ansiedelung," "Arch. f. Gyn.," Bd. lxxvi, H. 2; also "Ueber das Chorioepitheliom in der Vagina bei sonst gesundem Genitale," Monograph, Hübl, Wien, 1903.

of the uterus usually causes distressing nausea and vomiting. Occasionally, after the development of the chorion villi, the disease is arrested and the ovum is retained for many months, so that in such cases there may be all the symptoms of pregnancy, with a previous history of bleeding, but the womb at the time of examination is much smaller than it should be at the date which the pregnancy has apparently reached. Vesicular mole is most apt to occur in women who have already borne children or who have reached middle age. Hirtzmann [1] found that, of 35 cases, 25 occurred in women over twenty-five years of age. As an exception to this rule, Stricker [2] reports a case of precocious menstruation in a child who in her ninth year gave birth to a true vesicular mole. It is hardly necessary to state that cystic degeneration of the chorion villi is necessarily a result of impregnation, and can not occur in a virgin uterus. In 100 cases collected by Dorland,[3] 68 occurred between the twentieth and fortieth year. In 210 cases collected by Findley,[4] the average age was twenty-seven; the extremes were thirteen and fifty-eight years. Cystic degeneration of the chorion often occurs in women who have previously given birth to healthy children, but it not infrequently recurs in the same individual. Depaul [5] mentions a woman who had this affection three times, and Mayer [6] has observed the disease in eleven successive pregnancies. The degenerated chorion usually determines the expulsion of the ovum at some period between the third and sixth months of gestation.[7] If, however, the disease does not begin until after the villi of the chorion læve have atrophied, or if the degeneration is confined to a comparatively limited area, the pregnancy usually proceeds to term. But, if the embryo is absorbed and the chorion becomes adherent to the uterine wall, the pregnancy may be abnormally prolonged to twelve or thirteen months (Schroeder). The adhesion of the cystic villi to the uterine wall has more serious results than the mere prolongation of pregnancy. It is often due to the perforation of the uterine wall by a proliferation of the syncytial cells of the chorion villi, and consequently when the mass is expelled there may be fatal hemorrhage from the uterine sinuses (Volkmann, Waldeyer), or, as in Wilton's case,[8] the peritoneal covering may be torn and fatal hemorrhage may ensue into the peritoneal cavity. The retention of a portion of the chorion may

[1] "Thèse de Paris," 1874. [2] Virchow's "Archiv," Bd. lxxvii, S. 193.
[3] "Am. Journ. of Obstet.," 1896, p. 905.
[4] "Am. Journ. of Obstet.," March, 1903.
[5] "Leçons de Clin. Obst.," 1872. [6] "Tarnier et Budin," p. 306.
[7] In Dorland's 100 cases the mass was expelled in 63 per cent. between the third and fifth months.
[8] "Lancet," Feb., 1840.

be followed by its decomposition within the uterine cavity, giving rise to general septicemia; or fragments of cystic chorion retained *in utero* may be expelled at a date remote from the original pregnancy. With these accidents, of not infrequent occurrence in the course of the disease, it is not surprising that the maternal mortality is eighteen to twenty-five per cent.[1]

Etiology and Frequency.—The occurrence of vesicular disease of the chorion can not be attributed to any single cause. The connection between disease of the endometrium (Virchow) or of the uterine walls (fibroid tumor (Schroeder)) and vesicular mole is clearly established in a large proportion of the cases, especially in those in which there is a frequent recurrence of the disease; but this explanation does not suffice for the degeneration in the chorion of one fetus while that of its twin remains healthy. In this case the disease is of fetal origin,—perhaps the result of the death of the fetus. Indeed, it has been claimed that the death of the embryo necessarily precedes the cystic degeneration of the chorion. That this view is incorrect is demonstrated by the birth of living children in cases of not too extensive degeneration of the chorion. It has been claimed that vesicular mole is the result of absence of the allantois (Hecker), or that possibly the allantois may contain no blood-vessels (Schroeder), thus depriving the villi of their blood-supply.

Stenosis of the umbilical vein has been found associated with cystic chorion, and, therefore, it has been asserted that the cystic degeneration may have been due to dropsy of the chorion villi (Maslowski, Robin). A pathological hyperplasia of the syncytium, possibly stimulated by an overgrowth of lutein cells in the ovary, followed by liquefaction of the cells in the interior, is the latest and most generally accepted theory to account for the disease. As to the frequency of this affection, there are no reliable statistics. Mme. Boivin[2] saw the disease only twice in 20,375 pregnancies, while in the Charité in Berlin it occurred four times in 2130 pregnancies. Eight cases have been under my care in twenty years. Every obstetrician of large practice has seen at least one case. Cystic degeneration of the chorion villi occurs probably once in two or three thousand pregnancies.

The treatment is mainly symptomatic. In cases of hemorrhage, it may be necessary to tampon the vagina until the os is sufficiently dilated to permit the expulsion of the cystic mass, or its extraction by the fingers, or by placental forceps. If the diagnosis of cystic disease of the chorion is made during pregnancy, and if abdominal or combined palpation gives no

1 Dorland, *loc. cit.*; Findley, *loc. cit.*

2 "Clin. Mem.," 1863.

signs of the presence of a fetus, the immediate induction of abortion is advisable so that the chorion shall not reach an inordinate size and penetrate the uterine wall, causing hemorrhage or possibly perforation of the uterus. A prolonged retention of the mass also predisposes to malignant degeneration of its epithelium. After the expulsion of the diseased ovum, if there are symptoms pointing to the retention and decomposition of fragments of the chorion within the uterine cavity, the natural impulse would be to remove the retained substances; but it must be borne in mind that the attenuation of the uterine wall in circumscribed areas may be so great that the slightest interference, the introduction of a curet, or the administration of an intra-uterine douche, may cause its rupture with a fatal result.[1]

The uterus should be packed with gauze after its evacuation to stimulate its contraction and to control hemorrhage. The patient should be kept under observation for months and years. If there is a tendency to metrorrhagia there should be a microscopic examination of endometrium removed by curettage. If evidence of chorion-epithelioma is discovered, a hysterectomy is urgently indicated.

Rupture of the Chorion.—Both the amnion and chorion may rupture, without terminating pregnancy. The fetus either remains within the amniotic cavity or escapes from its ovular envelopes and continues its development in direct relationship with the deciduæ (extramembranous development[2]).

Fibromyxomatous Degeneration of the Chorion.—If fibrous tissue predominates between the degenerated villi, the mass is solid instead of cystic. Virchow[3] first called attention to this condition in the placenta, and gave it the name of myxoma fibrosum placentæ. In the midst of healthy cotyledons one was discovered affected by a fibromucous degeneration. A similar structure may be found in the peripheral layers of the umbilical cord.

To complete the study of diseases of the chorion it is necessary to mention a chronic inflammation of the membrane.[4] In the case, already referred to, in which the amnion was ruptured during pregnancy, the irritating effect of the liquor amnii upon the chorion produced a thickened and hyperplastic condition of that membrane.

[1] For a case resulting fatally after the injection of perchlorid of iron, see Priestley, *loc. cit.*, p. 41.

[2] Maroger, "Thèse de Paris," 1904.

[3] *Op. cit.*, S. 414.

[4] Lebedeff, quoted by Tarnier, *op. cit.*, p. 313.

THE PLACENTA.

The placenta, as a separate organ, dates from the third month of pregnancy. At this time the chorion villi atrophy over the whole periphery of the ovum, except at the point where it comes

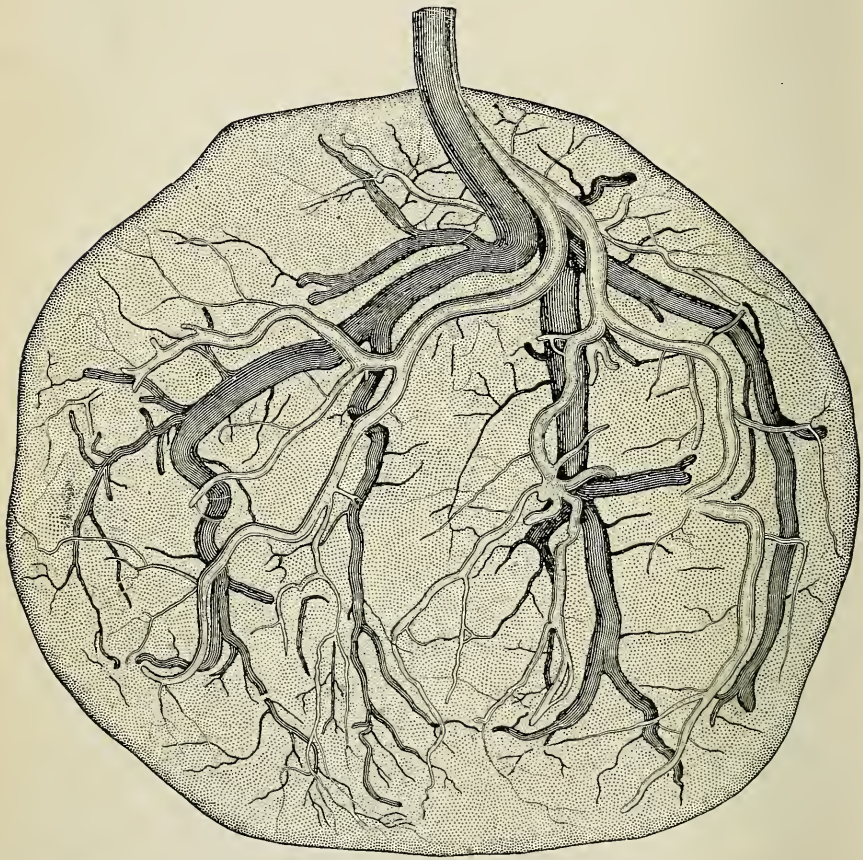


Fig. 83.—The fetal surface of the placenta (Minot).

in direct relation with the true mucous membrane of the uterus—the decidua serotina. Here the villi take on an extraordinary growth, forming buds of epithelial cells (syncytium) upon their surface, which rapidly take on the shape of new villi, thus sending out branches in every direction, into each of which a loop of blood-vessels is projected. Separating the villi from one another, and dipping down to the base of the chorion between

the parent stems of the villous projections, are processes of the decidua, carrying capillary loops of maternal blood-vessels. Very early in the history of the ovum[1] the arterioles of this system open directly into the intervillous spaces of the placenta, so that the placental villi are bathed directly in maternal blood. So far almost all authorities are agreed, but as to the relation of the terminal villi to the uterine mucous membranes, the action of the chorional and decidual epithelium, the changes that convert the uterine capillaries at first surrounding the villi into the large blood-sinuses that are later found in the placenta, many conflicting theories have been advanced. As to the relation between the placental villi and the uterine mucous membrane, it has been variously stated that the former enter the mouths of the uterine glands (Bischoff); that they sink into crypts in the uterine mucous membrane, which are new formations especially adapted for their reception (Turner); that the villi do not sink into glands or crypts, but are intimately invested with a layer of decidual epithelium, or with an endothelial covering derived from the maternal blood-vessels (Ercolani); and that this cell-covering acts as a glandular structure, secreting from the maternal blood a peculiar substance, the so-called "uterine milk," which acts as nutriment for the fetal blood (Ercolani, Hoffman). It is now well established, however, that the placental villi imbed themselves in the soft interglandular substance of the decidua serotina, often projecting into the mouth of the small veins, and that the connective-tissue cells multiply and hypertrophy around them (decidual cells). The epithelium of the uterine mucous membrane disappears, except in the glands. The chorion villi are at first covered with two distinct layers of cells; an inner layer composed of single large nucleated cells arranged side by side with distinct cell walls (Langhans' layer), and an outer layer or band of protoplasm in which are imbedded nuclei at irregular intervals (the syncytium). Both of these layers are derived from the chorion and not from the uterine epithelium or the endothelium of the uterine blood-vessels. Early in embryonal life (the third month) the Langhans layer disappears and the syncytium remains as the sole epithelial covering of the villi. In the youngest ova yet observed the trophoblast contains lacunæ to which blood is conveyed from the maternal circulation by little curling arteries that wind their way up through the decidual cells to empty directly into the placental sinuses. These arteries are provided with only a delicate endothelial wall. From Leopold's[2]

1 In Leopold's ovum of seven to eight days this arrangement was already visible. "Uterus u. Kind," Leipsic, 1897.

2 *Loc. cit.*

observations it appears that the arterioles of the decidua become more and more distended as they approach the placental villi, so that their terminal expansions may be compared to a sea into which project peninsulas and capes of decidual masses and placental villi. The syncytial cells of the latter have the power to penetrate the endothelium of the decidual arterioles and thus open a direct communication between the placental villi and the maternal blood. By this anatomical arrangement the fetal and maternal blood is, of course, kept separate. The former circulates within the capillary system of the villi; the latter bathes the exterior of the villi.

Fig. 84.—The capillary system of a placental villus (from Minot).

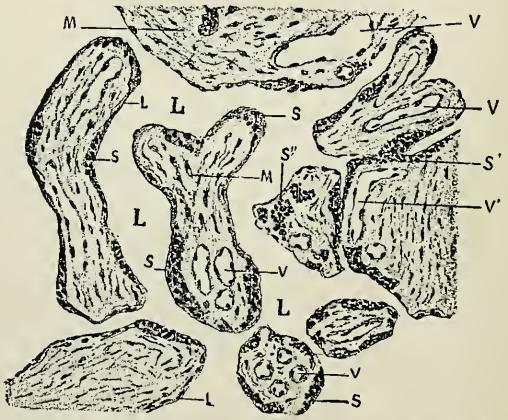


Fig. 85.—Section of placental villi of a normal placenta at term: M, Fetal mesoderm; S, syncytial masses; V, V′, fetal vessels; L, maternal lacunæ, containing maternal blood (Durante).

The Fully-developed Placenta.—The placenta at term is a circular mass, measuring about seven inches in diameter, about two-thirds of an inch to an inch in thickness at the point of insertion of the cord, and weighing about sixteen ounces. Upon

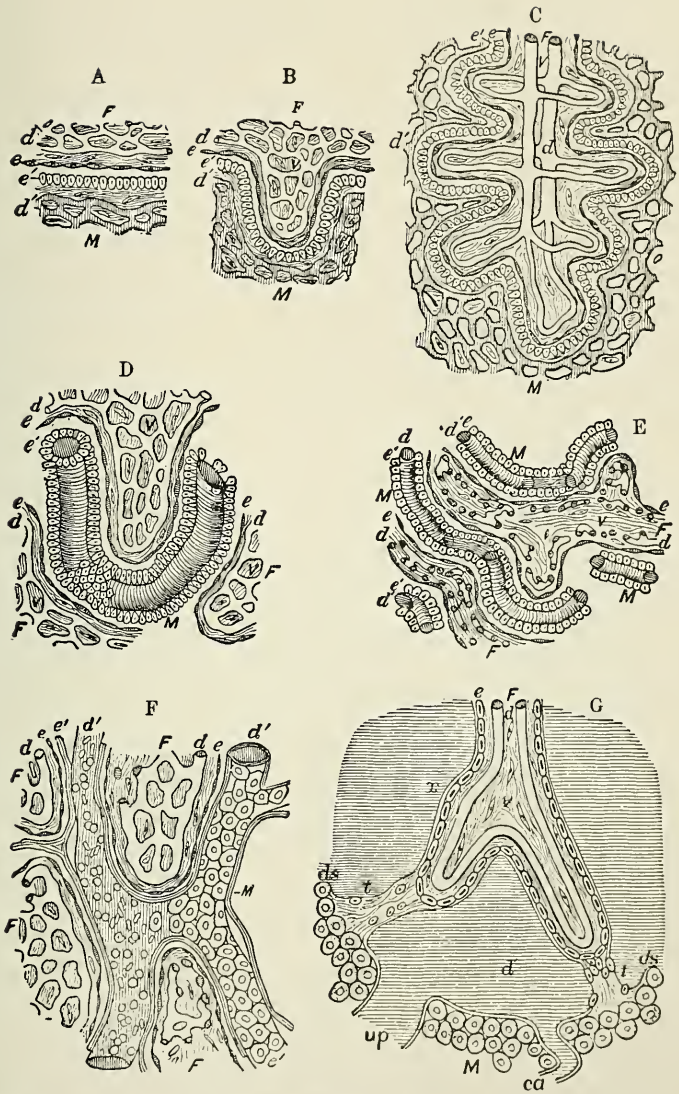


Fig. 86.—A, Placenta in its most generalized form; B, structure of placenta of pig; C, structure of placenta of cow; D, structure of placenta of fox; E, structure of placenta of cat; F, structure of placenta of sloth; on the right side of the figure the flat maternal epithelial cells are shown *in situ*; on the left side they are removed, and the dilated maternal vessel with its blood-corpuscles is exposed; G, structure of human placenta; *F*, fetal, and *M*, maternal placenta; *e*, epithelium of chorion; *e'*, epithelium of maternal placenta; *d*, fetal blood-vessels; *d'*, maternal blood-vessels; *v*, villus. The succeeding references apply to G only: *ds*, Decidua serotina of placenta; *t*, trabeculæ of serotina passing to fetal villi; *ca*, curling artery; *up*, uteroplacental vein (from Balfour, after Turner).

the surface of the placenta into which the cord enters is seen a smooth, shining membrane, continuous with the sheath of the cord,—the amnion. The fetal side of the placenta contrasts strongly with the maternal surface. The latter is of a dark-red hue, divided by deep sulci into lobules of irregular outline and extent,—the cotyledons. Over the maternal surface of the placenta is stretched a delicate, grayish, transparent membrane, which is made up of the cells that compose the upper layer of the decidua serotina. This constitutes the maternal portion of the placenta. In separating from the uterine wall, therefore, the line of separation does not divide the fetal from the maternal structures, but is found in the mucous membrane of the uterus, in the lower portion of the cellular layer of the decidua. Around the periphery of the placenta may be seen a large vein, the circular vein of the placenta, which returns a part of the maternal blood from the organ, the remainder returning to the maternal circulation by means of the continuity between the placental lacunæ and the uterine sinuses. The situation of the placenta within the

Fig. 87.—Surface of villus at three weeks, showing syncytial band, A, and Langhans' cells, B (500 enlargement); C, stroma of villus.

uterus may with equal frequency be found upon the posterior or the anterior wall; occasionally, however, upon one of the lateral walls, more frequently the right.

A perpendicular section through the middle of a placenta that is still attached to the uterine wall reveals an intimate connection between the two. The delicate terminal villi, and even branches a millimeter in thickness, are imbedded in the upper portion of the decidua, and held in place by their extremities bulging out into club-shaped masses, so that the exercise of considerable force will not extract them from the uterine mucous membrane, but will, instead, always lacerate the maternal structures.

The functions of the placenta are manifold. Not only does it act as a lung, or, rather, gill, in oxygenating the fetal blood, but it may be said to take the place of the alimentary tract in absorbing nutritive material from the maternal circulation. It plays, moreover, the part of an excretory organ, getting rid of the surplus carbonic acid gas in the fetal blood and of the other waste-products of tissue-activity. Bernard has shown that in the earlier months of pregnancy the placenta has a glycogenic function. The epithelial cells of the chorion villi exercise selection in the passage of substances between the fetal and the maternal blood. Some pathogenic micro-organisms—as, for instance, those of variola—pass easily from mother to fetus, while the bacilli of tuberculosis, a disease often present in pregnant women, are almost never found in the

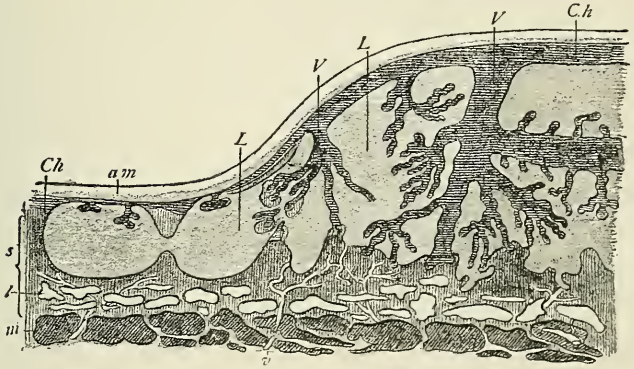


Fig. 88.—Diagram of uterus and placenta in the fifth month: *Ch*, Chorion; *am*, amnion; *V*, *V*, villi; *L*, *L*, lacunæ; *s*, serotina; *v*, small arteries; *l*, glandular layer; *m*, uterine muscle (Leopold).

fetus. Certain drugs, also (iodid of potassium, benzoic acid, bichlorid of mercury), enter the fetal from the maternal blood, while it is asserted that others, as woorara, will not pass to the fetus from the mother. Again, while nutritive material must pass from mother to fetus, the escape of the same material from the fetal into the maternal blood would prove destructive to the fetus.

Anomalies of the Placenta.—The placenta may present deviations from the normal in size, position, shape, weight, or number. Its structure may present anomalies the result of diseases or accidents, and there may be anomalies of function.

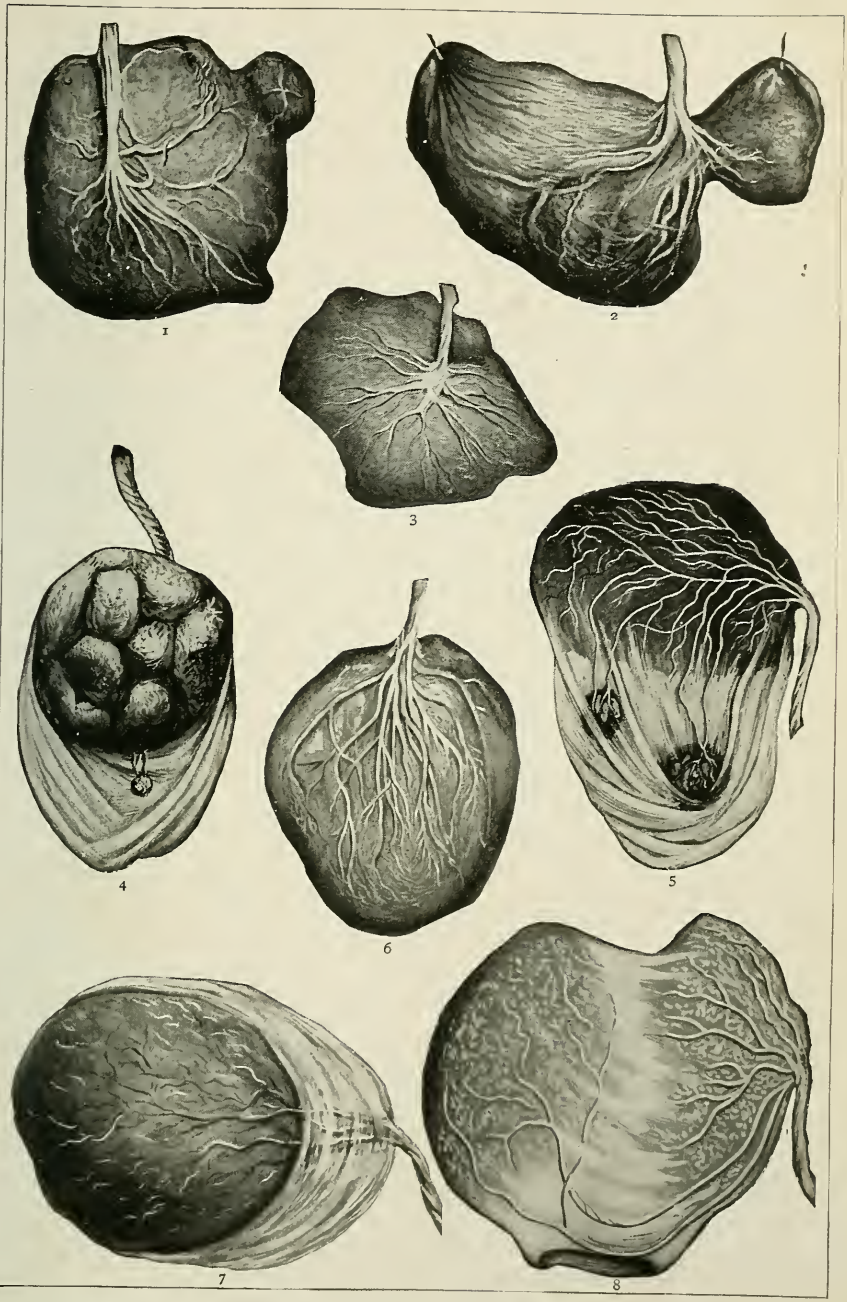
Anomalies of Position, Size, and Weight.—The position of the placenta is normally near the fundus uteri. A low insertion

is a cause of *placenta prævia*. The size of the placenta varies considerably. Its thickness is in inverse ratio to its extent, and the younger the ovum, the greater the relative size of the placenta. The placenta has been known in rare cases to extend around the whole periphery of the ovum. This condition is called placenta membranacea, and is explained by the equal development of all the chorional villi. The placenta may be abnormally thick and enlarged in all directions, from the hyperplasia due to a chronically inflamed endometrium. An abnormally small placenta may be associated with an ill-developed child, may depend upon an interstitial overgrowth with subsequent retraction, or may be due to atrophy of the decidua.

Fig. 89.—Placentæ of triplets.

Anomalies of Shape and Number.—The placenta, usually round or oval, may have a horseshoe or crescentic shape, especially if it is inserted near the internal os, which is surrounded by the two arms of the crescent. In multiple pregnancies (not unioval) each child has its own placenta (Fig. 89). A single child may have two (placenta duplex), three (placenta tripartita), or more placentæ (placenta multiloba), or a single placenta may be reinforced by one or more small accessory placental developments (placentæ succenturiatæ), which are in direct communication with the blood-sinuses of the decidua vera. If the villi of these accessory growths do not communicate with the maternal blood, they are called placentæ spuriæ. Taurin[1] has

[1] "Nouv. Arch. d'Obstét.," 1893, p. 486.



Anomalies of the Placenta: 1, Placenta with irregular lobes (Auvard); 2, placenta in two unequal lobes (Auvard); 3, irregular placenta (Auvard); 4, small accessory placenta (Ribemont-Lepage); 5, placenta succenturiata (Ribemont-Lepage); 6, "battledore" placenta, oval (Auvard); 7, placenta with velamentous attachment of cord (Ribemont-Lepage); 8, placenta with two equal lobes (Ribemont-Lepage).

reported a case of annular placenta, extending almost completely around the ovum as it does in some animals, but separated indistinctly into three lobes.

Edema of the Placenta.—A serous infiltration of the whole placenta is often observed with a dead and macerated fetus.[1] The same condition is often associated with general anasarca of the fetus, with some obstruction of the umbilical vein or of the venous system of the fetus, or with a greatly hypertrophied placenta which absorbs more fluid than the fetal economy can dispose of (Werth). The minute anatomy of the placenta may remain normal in this disease and the placenta may continue to perform its physiological functions.

Degeneration of the Placental Villi.—The morbid processes abrogating the physiological activity of the placental villi are hypertrophy; fibrous and fatty, caseous (phthisical placenta), calcareous, and myxomatous degenerations. Placental hemorrhages, placental syphilis, and solid tumors of the placenta have, as a result, the destruction of all or a part of the placental villi as factors in the nutrition and aëration of the fetal blood, but these conditions are considered separately.

"Placental infarcts," so commonly seen as whitish nodes in the majority of placentæ, are examples of a fibrous degeneration due, according to Williams, to an endarteritis of the vessels of the villi, a coagulation-necrosis, and the formation of canalized fibrin.[2]

Myxomatous Degeneration.—The myxomatous degeneration that has already been studied in the chorion villi may be confined to the placenta, while the extraplacental chorion remains healthy. Myxoma fibrosum placentæ has been described by Virchow,[3] Storch (two cases),[4] Hildebrandt,[5] and Sinclair.[6]

Calcareous Degeneration.—Depositions of small quantities of lime in the placenta are not at all uncommon. They are usually to be found in that portion of the maternal placenta lying nearest the villi, or they may originate in the villi themselves. Chambord[7] has found as many as five hundred concretions in one placenta. It has been said that extensive calcification of the placenta is more apt to occur after the death of the fetus, but Tarnier asserts that there is no relation of cause and effect between the two, and that the occurrence of large calcareous deposits in the placenta with still-born children is a mere coincidence, as it

[1] Tarnier et Budin, *op. cit.*, p. 329.

[2] "The Frequency and Significance of Infarcts of the Placenta, Based upon the Microscopic Examination of 500 Consecutive Placentæ," Whitridge Williams, Johns Hopkins Hosp. Rep., vol. ix.

[3] *Loc. cit.*, p. 414.

[4] Virchow's "Archiv," 1878; and Breus' "Wien. med. Wochens.," 1881, No. 40.

[5] "Monat. f. Geb.," Bd. xxxi, S. 346. [6] "Jour. Obstet. Soc.," Boston, 1871.

[7] "Lyon Médicale," 1873, p. 431.

is also in cases in which calcareous degeneration is associated with syphilis.[1]

In 1873 Fränkel claimed to be the first to demonstrate that the "deforming granular hyperplasia and hypertrophy of the placental villi," described by Ercolani, without reference to its connection with syphilis, was the most frequent form of placental syphilis.[2]

According to Fränkel, this infiltration of the villi with granulation-cells, and their consequent increase in size and distorted shapes, are characteristic of syphilis. The seat and extent of the lesion vary with the manner and time of the fetal infection. If the

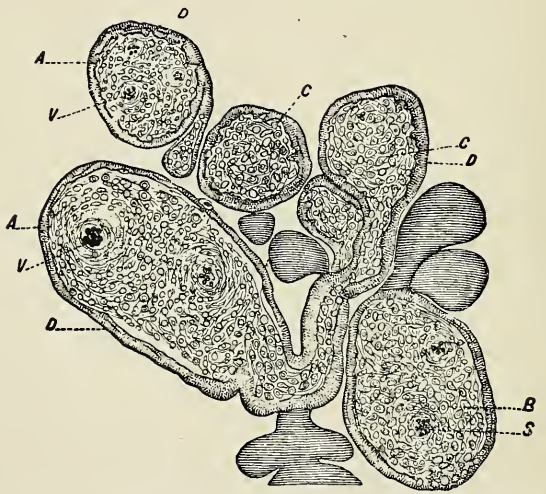


Fig. 90.—Section of villi, showing small-cell infiltration and the deformed shapes of villi: *A,A*, Luxuriant cell-development in the interior; *V, V*, lumen of blood-vessels with hypertrophied walls; *B*, villus in which only a trace of blood-vessels can be seen at *S; C,C*, villi without trace of vascular canal; *D,D,D*, epithelial covering (Fränkel).

ovule is infected by the impregnating spermatic particle, the placenta, if diseased at all, constantly presents the granulation-cell infiltration of the villi and the degeneration of their epithelial covering. If the mother is infected during the fruitful coitus, there may be endometritis placentaris, characterized by an enormous overgrowth of the decidual cells or the overgrowth of connective tissue as well as syphilitic disease of the villi. If the mother is syphilitic before conception, the disease of the placenta takes the form of endometritis placentaris gummosa. If the mother is

[1] See also Fränkel, "Archiv f. Gyn.," Bd. ii, S. 373; Winckler, "Archiv f. Gyn.," Bd. iv, S. 260; Langhans, "Archiv f. Gyn.," Bd. iii, S. 150.

[2] "Ueber Placentar Syphilis," "Archiv f. Gyn.," Bd. v, S. 6.

infected during the latter months of pregnancy, the placenta usually remains unaffected. Fränkel bases these conclusions upon the examination of more than one hundred specimens, and his views have been confirmed by Hening and McDonald. Federoff,[1] on the contrary, declares that Fränkel's disease is not constant. Efforts to find the spirochæta pallida in the placentæ of syphilitic fetuses have met with variable results. Cappellani failed in three cases. Guicciardi, Mohn, Wallich, Levaditi, Nathan, Larrier, Brindeau, and others have succeeded.[2]

In their macroscopic appearances syphilitic placentæ may differ considerably. If the child has been dead some time, the placenta may be almost white in appearance, soft and greasy in feel. If the child is expelled alive at term, the placenta is often unusually large and of a pinkish color, due to the thickened decidua, which prevents the true color of the organ from appearing. There may be organized clots, showing a previous hemorrhage into the placenta or the occurrence of thrombosis in the lacunæ; or there may be nodes[3] of varying extent, lamellated in structure and undergoing degenerative changes in the central portions. Frequently there is extensive calcareous degeneration.

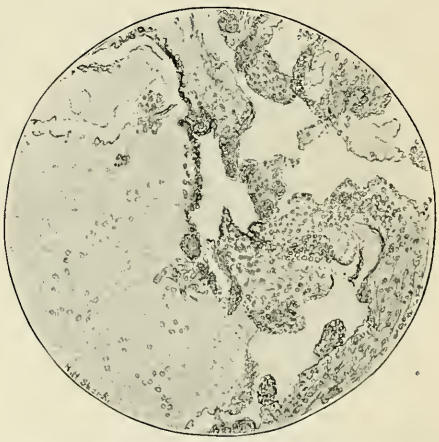


Fig. 91.—Syphilitic disease of the placenta, showing Fränkel's disease.

The consequence of syphilitic disease of the placenta is usually disastrous to the fetus and often dangerous to the mother. The cellular infiltration of the villi obliterates the blood-vessels within them, and consequently abrogates their functions. The same effect may be produced by the hyperplasia of the decidua serotina and the consequent encroachment of the decidual tissue upon the intervillous blood-spaces, or the destruction of the villi may be brought about by the formation of the nodular masses that have been noticed. The endometritis placentaris that is often

[1] "Inaug. Diss.," St. Petersburg, 1904.

[2] "Archiv di Ostet. e Gin.," No. 13, 1906; "La Ginecologia," No. 3, 1906; "Muench. med. Wochenschr.," No. 47, 1906; "Ann. de Gyn. et d'Obstét.," Feb., 1906; "Le Progrés Méd.," p. 86, 1906.

[3] Ziller, "Studien über Erkrankungen der Placenta," etc., Tübingen, 1885.

a prominent feature of placental syphilis may prove dangerous to the mother by matting the layers of the decidua serotina together, thus subjecting the woman to the perils of hemorrhage, septicemia, or inversion of the uterus that are incidental to adherent placentæ.

Tuberculosis of the Placenta.—From an examination of 26 specimens Schmorl[1] declares that all the component parts of the placenta may be infected at any stage of pregnancy and in any grade of the maternal disease.

Placental Hemorrhages.—The term placental hemorrhage is used to indicate circumscribed collections of blood that have undergone more or less change. The blood may be found as a fresh clot, sometimes occupying a large area, especially when abortion follows the premature detachment of the placenta; the extravasated blood may be encapsulated, surrounded by a fibrous wall of varying thickness, within which is a reddish or a brownish fluid; the cyst may contain nothing but clear serum, while the coloring-matter of the blood is deposited upon the cyst-wall or upon the surrounding villi.[2] The encysted hematocele may contain large numbers of white blood-corpuscles undergoing fatty degeneration, giving rise to a liquid resembling pus. Such cases have been described as abscesses of the placenta.

The fibrin may predominate, as in the cases of thrombosis of the placental sinuses described by Bustamente[3] and Slavjansky,[4] in which, if the clot is slowly formed, the resulting mass consists of laminated fibrin, as in aneurysms undergoing obliteration. In other cases the serum is rapidly absorbed, and there is left a mass of red globules containing white corpuscles, either heaped together or scattered through the mass. Finally, the clot may organize, and thus form a distinct neoplasm in the placenta. The placental villi surrounding the extravasated blood usually undergo a fibro-fatty change.

The causes of placental hemorrhage are manifold. The predisposing causes are pelvic congestion and albuminuria (Winter, Fehling); the slow-moving blood-current in the placental sinuses and the excess of fibrin in the blood of pregnant women, predisposing to thrombosis; and diseased conditions of the placental villi. The determining cause may be a sudden, powerful action of the heart; syncope, favoring the formation of a thrombus; or external violence. In the early

[1] "Muench. med. Wochenschr.," No. 38, 1904.

[2] Ercolani has described a case of "placental melanosis" in which there was no trace of blood-extravasation, but the villi were infiltrated with pigment granules ("Archiv de Toc.," 1896, p. 193).

[3] *Loc. cit.*

[4] "Archiv f. Gyn.," 1873, Bd. v, 360.

months of pregnancy hemorrhage is most frequently due to a true apoplexy, a rupture of the delicate new-formed blood-vessels in the decidua. Later, it is more frequently thrombosis in the sinuses, or the laceration of the delicate blood-vessels that perforate the upper layer of the decidua serotina to enter the placental sinuses.[1]

The consequence of placental hemorrhage to the fetus depends upon the amount of blood extravasated. Should the quantity be large, either the number of villi strangulated by the clot is so great that the fetus is at once asphyxiated, or else the escaping blood is able, especially in the earlier months, to strip the placenta off from the uterine wall, with the same result. The effect of placental hemorrhage upon the mother is usually unnoticeable, except in case the fetus is killed, when the whole ovum may be prematurely expelled. In some instances, however, the blood forces itself between the placenta and uterus, and, burrowing its way downward through the layers of the deciduæ, makes its appearance externally as a hemorrhage from the uterus. Or else the blood, unable to escape, collects at the placental site, or possibly over a large area, sometimes in such quantities as to form distinctly an additional tumor of the uterus appreciable through the abdominal walls, and also to give rise to all the symptoms of internal hemorrhage.

Cysts of the placenta are not rare. In the majority of cases they are the result of hyperplasia of the cells of Langhans' layer and subsequent liquefaction of a secretion from these cells. They are sometimes due to a circumscribed, unusually fluid myxoma.[2] Jacquet[3] has described small cysts springing from the blood-vessel walls.

Tumors of the Placenta.—The tumors of the placenta formed in the fibromyxomatous degeneration of the villi have already been noticed. Organized blood-clots have also been described as tumors of the placenta. Hecker[4] speaks of a fleshy substance expelled from the uterus post-partum, although the placenta had come away entire, as possibly a placental tumor. This may, however, have been nothing but a uterine polypus or a piece of hypertrophied and angiomatous serotina.[5]

Malignant growths at the placental site have long been recog-

[1] My friend Dr. Robert H. Hamill, of Philadelphia, has shown me a specimen exhibiting an interesting variety of placental hemorrhage. Immediately beneath the amnion there was a large clot occupying more than half the area of the placenta, and evidently containing all the blood of the fetal body. The fetus, corresponding in development to the fourth month, had bled to death into its own placenta from the rupture of a large branch of the umbilical vein.

[2] "Archiv f. Gyn.," Bd. xi, S. 397.

[3] "Gaz. méd. de Paris," Oct. 14, 1871. [4] "Klinik der Geburtsh.," 1864.

[5] See paper by the writer in "Am. Jour. Obstetrics," Dec., 1887.

nized under the name of malignant placental polyps. In 1888 Sänger described a sarcoma of the decidua serotina. His article attracted great attention and was immediately recognized as most important both in the nature of the tumor described and in its histology. The attention of physicians all the world over being directed to the matter, malignant tumors of the placental site were found to be rather common. The author saw five in as many years. In 2700 autopsies in the Vienna General Hospital, from February, 1901, to August, 1902, seven cases were discovered. It was soon realized, however, that the majority of the

Fig. 92.—Syncytial cancer: Masses of fibrin, *A*, containing islands of proliferated syncytial cells.

growths observed were carcinoma and not sarcoma, and a close study of their histology demonstrated the fact that cancer has its origin in the syncytial cells of the chorion villi. In the metastases the syncytium of the placenta is every where produced. From recent sections of the original tumor studied by [illegible] it appears that it really was a sarcoma. It is now that both sarcoma and carcinoma may develop at site, the former from the decidual cells (deciduo-sarcoma, deciduoma malignum), the latter from the syncytium (chorio-epithelioma, carcinoma syncytiale, syncytial cancer, syncytioma malignum). Cancer of the placental site is vastly more common than

sarcoma. Gaylord has collected 55 reported cases; Veit,[1] 89; Teacher,[2] 189; and Briquel,[3] 254. Both of these malignant growths have a rapid course, ending fatally in from three to six months. Metastases are numerous and occur early. A metastatic growth of syncytial cancer is possible without a trace of the original tumor. Schmorl[4] reports a syncytial cancer of the vagina

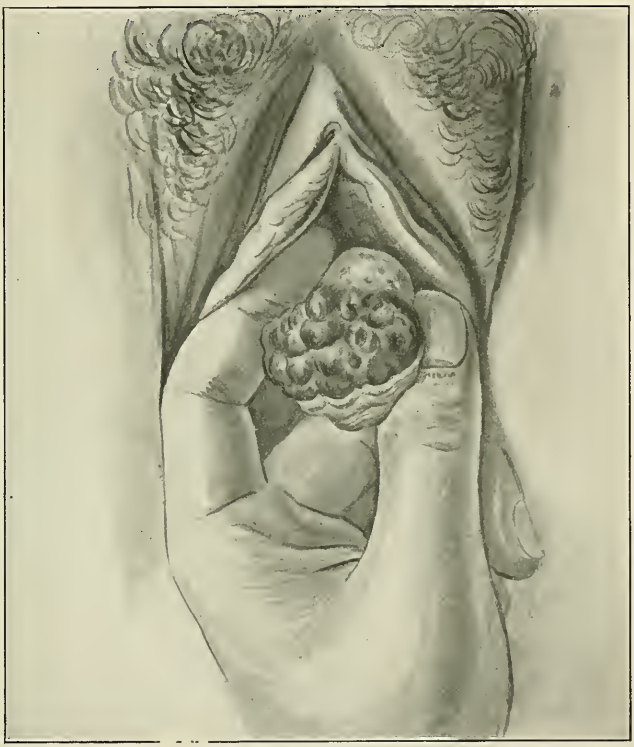


Fig. 93.—Chorio-epithe[illegible] of the vagina without involvement of the rest of the genital tract (Hübl).

with numerous metastases, the uterus being healthy. It is supposed that the original growth is removed with the exfoliation of the decidua serotina, or that there is metastasis of chorion villi, followed by malignant degeneration of their epithelium.[5]

[1] "Tr. of [illegible] Section on Gyn.," College of Physicians of Philadelphia, 1898.
[2] "Journ. of Obstet. and Gyn. of the Brit. Empire," August, 1903.
[3] "Tumeurs du Placenta et Tumeurs Placentaires," p. 620, Paris, 1903.
[4] "Centr[illegible]l. f. Gyn.," 1896
[5] Zagorjanski-Kissel has collected 17 cases; *loc. cit.*

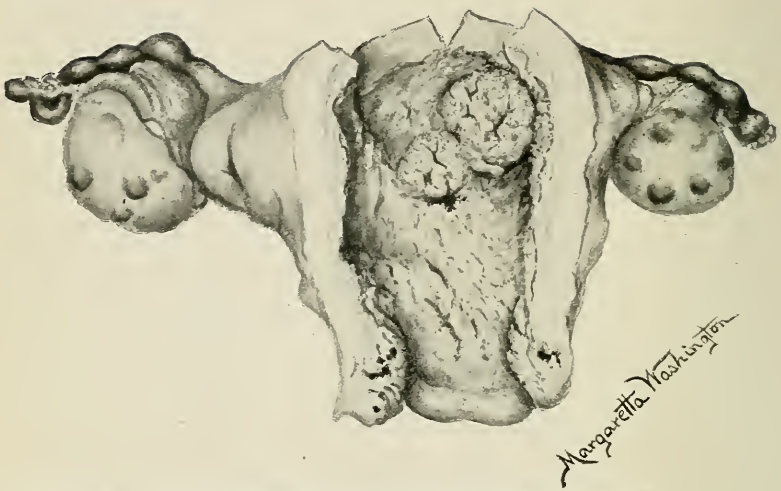


Fig. 94.—A chorio-epithelioma, from which the exuberant growth had been completely removed by a curettage the day before the panhysterectomy.

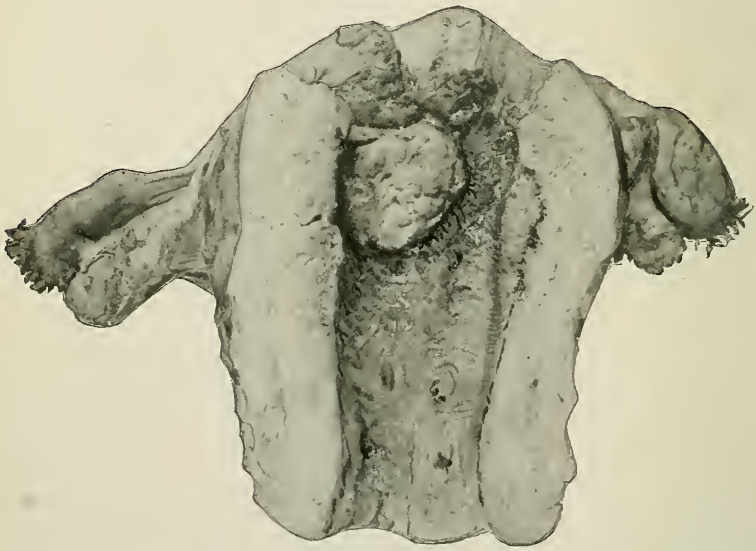


Fig. 95.—Neoplasm of the endometrium, opposite the placental site, diagnosticated as chorio-epithelioma, but consisting of leukocyte and small round-cell infiltration, possibly a barrier against syncytial invasion of the myometrium.

Stoeckel, Runge and Jaffé, and Pick[1] have demonstrated an invariable association with chorio-epithelioma, in all the cases

[1] "Centralbl. f. Gyn.," No. 34, 1903; see also Krebs, "Centralbl. f. Gyn.," Oct. 31, 1903, No. 44; "Arch. f. Gyn.," Bd. lxxi, H. 3.

PLATE 4.

Chorio-epithelioma: Removed by pan-hysterectomy during puerperal convalescence from a premature delivery. Patient without recurrence a year after the operation.

they examined, of an over-production of lutein and frequently of multiple corpus luteum cysts and an infiltration of the ovarian stroma by lutein cells.

The association of hydatidiform mole and chorio-epithelioma is intimate. Briquel found that in 45.5 per cent. of 217 cases the degeneration of the villi had preceded the cancer.

Symptoms and treatment: Profuse uterine bleedings with a foul-smelling discharge weeks, months, and even years[1] after an abortion or delivery at term should arouse suspicion of a malignant growth. If friable neoplastic masses of a dark purple color are removed, and recur with the original symptoms in a few weeks, the suspicion is strengthened. A microscopic examination of the material removed may make the diagnosis certain, but the penetration of the myometrium by syncytial cells, always observed in pregnancy and exaggerated in cases of retained fragments of placenta or other diseases of the endometrium, must be remembered. Metastases are often observed in the vagina. The uterus is large and soft, the os patulous. Chorio-epithelioma has been demonstrated in dermoids of both the ovary and testicle, in a young virgin and in the brain of a man, derived from a trophoblast developed in the course of a dermoid growth.[2] Schmorl and Hübl report metastatic growths in the vagina, the uterus being healthy. Either exfoliation of the original growth occurred or there was a deportation of chorion villi with subsequent malignant degeneration.

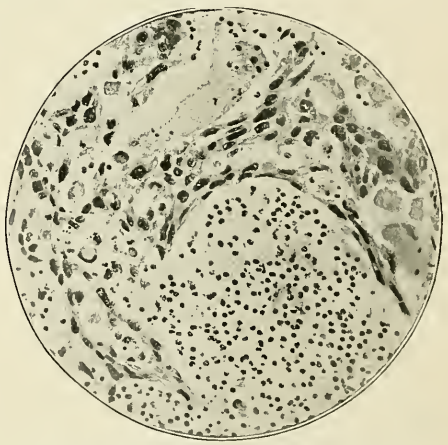


Fig. 96.—Metastasis of syncytial cancer in liver, showing cells from Langhans' layer and true syncytial cells.

A striking peculiarity of chorio-epithelioma, differentiating it from all other malignant growths, is the occasional disappearance of metastases after the removal of the original tumor. This remarkable fact is best explained by the theory that the organism produces an antibody (syncytiolysin) to antagonize the hyper-

[1] Veit mentions cases occurring two, three and one-half, and three and three-fourth years after delivery. "Handbuch der Gynäk.," iii, 2, p. 585.

[2] Zabinsky, "Zentralbl. f. Gyn.," No. 18, 1904.

plasia of the syncytium; that this antibody may be overwhelmed by the exuberant growth of the syncytium, but that if the original and largest mass of proliferating syncytium is removed, the normal balance between syncytiolysin and syncytium is restored, resulting eventually in the destruction of the metastatic growths.[1]

The treatment is a hysterectomy at the earliest possible moment after making the diagnosis. Veit has collected 29 successful operations out of 89 cases. Teacher's statistics give 63.6 recoveries in 99 cases.

Other tumors of the placenta are myxomata fibrosa, localized hypertrophies, angiomata,[2] and organized thromboses. Bode and Schmorl[3] report as a tumor of the placenta (fibroma) a fibrous degeneration of a placenta succenturiata. They have collected the reports of thirty placental tumors. Albert (*loc. cit.*) adds six cases to their list. Placental polyps developing at the placental site after labor are due to a sort of stalactitic deposit of blood-fibrin on a mass of decidua or a fragment of placenta. Localized tumors in the placenta are rare. Leopold in more than 7000 specimens found such a tumor only once.[4]

THE UMBILICAL CORD OR FUNIS.

The early development of the umbilical cord, or the formation of the allantois, has been studied upon the lower animals, as in all the human embryos observed the connection between the embryo and the chorion was already established. Indeed, according to His, the human embryo is from the first in connection with the periphery of the ovum. Very early, therefore, in embryonal life there may be observed a sac-like projection from the posterior end of the intestinal tract, which, at first solid, but later containing a canal, grows outward and backward, owing to the presence of the large umbilical vesicle anteriorly, until it comes in contact with the periphery of the ovum. Within this sausage-shaped [5] projection are blood-vessels, which are carried with its growth to the periphery of the ovum, where they enter the villi of the chorion in the manner already described. Reduced to two arteries and a vein within the allantois itself, they constitute the vessels of the umbilical cord, which are destined to carry the blood of the fetus to the placenta for aëration and nutrition, the two arteries conveying dark, venous blood; the vein

[1] See Hegar's "Beiträge," vol. viii.

[2] Albert, "Archiv f. Gyn.," Bd. lvi, H. 1, p. 144; C. Finzi, "Archivio di Ostet. e Gin.," No. 9, 1904.

[3] "Archiv f. Gyn.," Bd. lvi, H. 1, p. 73.

[4] V. Mars, "Monatschr. f. Geburtsh. u. Gyn.," Bd. iv, H. 3, p. 229.

[5] Ἀλλᾶς, a sausage.

returning bright, oxygenated blood, resembling in this respect the pulmonary arteries and vein. Surrounding the blood-vessels of the cord is a peculiar gelatinous substance, furnishing

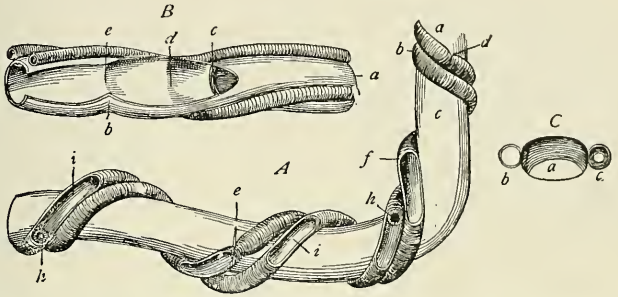


Fig. 97.—*A*, Umbilical arteries forming spirals (*i*, *i*) around the vein; constrictions indicating the presence of folds (*d*, *e*); circular folds (*d*, *e*); lateral openings showing the arterial walls; *B*, vein opened upon the side showing a constriction (*b*) corresponding to an interior valve (*e*); semilunar valves (*c*, *d*, *e*); *C*, section of vein and arteries showing valve of vein (*a*), a semilunar arterial valve (*b*), and a circular arterial valve (*c*) (Tarnier et Chantreuil).

the vessels the most perfect protection possible under the circumstances (the so-called gelatin of Wharton), derived from the outer layers of the amnion and the allantois, both in their turn being derived from the median layer of the blastodermic membrane. As the amniotic cavity is distended the amnion is pushed out on all sides until it meets in front of the embryo, and surrounds the cord like the finger of a glove, at the same time inclosing the already atrophied umbilical vesicle, the

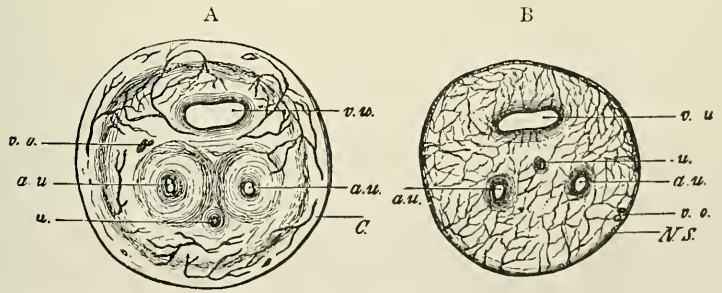


Fig. 98.—A, Section of the navel: *C*, Outer covering with blood-vessels; *v.u.*, umbilical vein; *a.u.*, *a.u.*, umbilical artery; *v.o.*, omphalic duct; *u.*, remnant of the urachus. B, Section of the cord: *N.S.*, Sheath of the cord. Other lettering as in A.

ductus omphalicus, and the pedicle of the allantois. That portion of the allantois that remains within the abdominal cavity of

the fetus forms the bladder and urachus. The umbilical cord at term measures about 50.8 cm. (20 in.) in length and about 0.9 to 1.3 cm. (⅓ to ½ in.) or more in diameter, the latter measurement being irregular, from the fact that the arteries are coiled around the vein, usually from right to left, giving a twisted appearance to the cord, and also because the gelatin of Wharton is deposited irregularly, being in some places quite thick, and forming thus the so-called false knots of the cord.

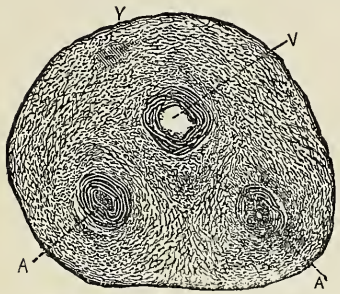


Fig. 99.— Cross-section of an umbilical cord at term, magnified about twelve diameters: Y, Remnant of the allantois; V, umbilical vein; A,A, umbilical arteries (from Minot).

Both the arteries and the veins of the cord have walls of almost the same thickness, and both are provided with semilunar and circular valves. The caliber of the vein is greater than that of the arteries. According to Leopold,[1] it measures normally 2 to 4 mm. (0.079 to 0.157 in.) in diameter, but at a point about 8 to 10 cm. (3.15 to 3.94 in.) from the placental insertion there occurs a physiological narrowing.

Anomalies of the Cord.—The cord may be abnormally long, measuring rarely as much as 70 inches (178 cm.),[2] or it may be naturally or artificially too short; and it may be absent altogether. The cord is artificially shortened in adhesive inflammations of the amnion which result in the agglutination of the coils or in their attachment to the fetal skin or amnion.

Exaggerated Torsion.—The cord may be so twisted upon its longitudinal axis that the vessels are nearly or quite obliterated, and the cord itself, especially near the umbilicus, is reduced to a very small diameter. Formerly the torsion was regarded as a cause of fetal death, but Martin, Ruge, Schauta, and most modern observers regard the exaggerated torsion of the umbilical cord as a postmortem occurrence, resulting from the great mobility within the uterine cavity of a fetus that has died from the fifth to the seventh month of pregnancy. The number of twists in the cord may be surprisingly great. In Schauta's[3] case it reached 380. Torsion occurs more frequently in male than in female children. Edema and cystic degeneration of the cord may often be found in connection with exaggerated torsion.

[1] "Archiv f. Gyn.," Bd. viii, S. 221.

[2] Chantreuil, "Disposition de Cordon," Paris, 1875. I have seen one cord 48 and another 56 inches long. The latter was coiled twice around the neck and once around the trunk.

[3] Leopold, "Archiv f. Gyn.," Bd. xvii, S. 20; see also Winckel, "Berichte u. Studien."

Stenosis of the Umbilical Vessels.—The umbilical vein may be narrowed by the development in the intima of new connective tissue [1] to such an extent as to seriously impede the flow of blood from the placenta,—a condition resulting in edema of the latter organ (hydramnios), or an immense dilatation—to 15 mm. (0.6 in.)—of the undiseased portion of the vein, ending occasionally in its rupture (Leopold) and the extravasation of blood into the substance of the cord. This disease of the vein is usually attributed to syphilis. A periphlebitis may also occur, and may diminish somewhat, but not seriously, the caliber of the vein. The umbilical arteries are occasionally obstructed by atheroma and thrombosis.

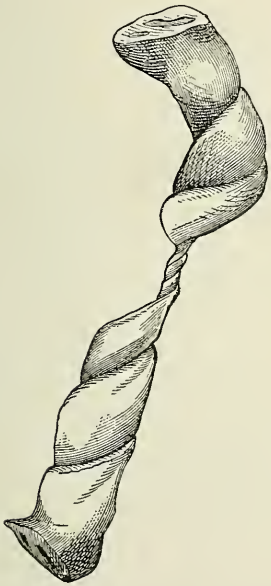


Fig. 100.—Torsion of the cord.

Fig. 101.—Distention of the umbilical vessels. Varices of the cord.

The section of an umbilical cord taken from a syphilitic infant sometimes shows an enormous development of connective tissue throughout the entire wall of the arteries, so that it is impossible to distinguish the different coats; the lumen of the vessels is often obliterated, not only by the thickened walls, but by the infiltration of the whole substance of the cord with granulation cells. Pinard [2] has seen the vessels of the cord obstructed

[1] "Neue Zeitschr. f. Geb.," Bd. iv, S. 62; and Leopold, *loc. cit.*
[2] "Dict. encyclopéd. des Sc. méd., art. "Fetus."

by an overdevelopment of the valves that are found in both arteries and veins.

Varices and Rupture of the Vessels in the Cord.—Figure 101 represents a varicose condition of the vein of the cord which predisposes to rupture. Five cases of this accident have been collected by Albert.[1]

True Knots of the Umbilical Cord.—Rarely the fetus slips through a loop of the cord, and, the two ends of the loop being then put upon the stretch, a true knot is tied. This process may be repeated either during pregnancy or while the child is descending in labor, and thus a double knot is tied. In the cord of an infant born under my care there was a true figure-of-8 knot tied (Fig. 102). In the case of twins in a common amniotic cavity the most complicated knotting of the two cords may occur. The effect of these knots in the cord upon the circulation of the fetus is usually not serious. Carl Braun[2] says

Fig. 102.—A false and a true knot in the cord (author's cases).

that he has never seen the slightest disadvantage to the fetus from this cause; but the knots can be drawn so tight as to completely shut off the placental blood-supply, especially in the case of twins in a single amniotic cavity, where one cord may be drawn in a tight knot about the other, obliterating the latter's blood-vessels. The gelatin of the cord is often displaced at the seat of the knot, so that when the latter is untied its situation is marked by deep depressions. "False knots" of the cord are localized collections of the mucous tissue in it. A loop of the cord may adhere by its proximal edges, giving rise to a lateral projection

[1] "Archiv f. Gyn.," Bd. lvi, H. 1, p. 136.
[2] "Lehrbuch der Ges. Gynäk.," p. 552.

such as is shown in figure 102, in which there is a loop of the three blood-vessels.

Coiling of the Cord Around the Fetus.—Loops of the cord may be wound about different portions of the fetal body. The

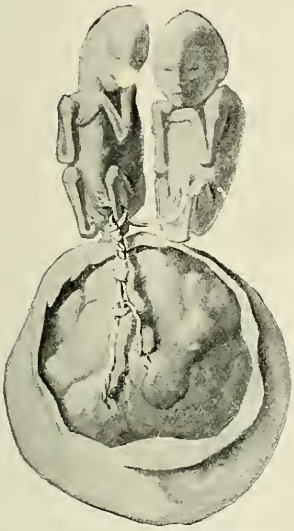


Fig. 103.—Entanglement of cords in twins (Winckel).

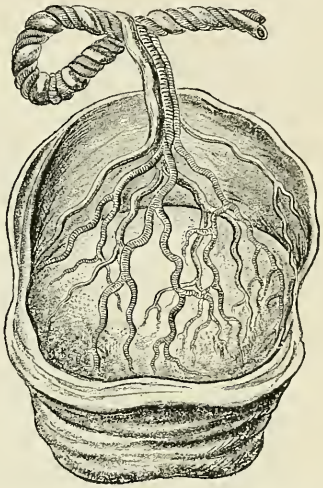


Fig. 104.—Velamentous insertion of cord.

neck may be encircled once or twice, more rarely from four to nine times (Braun), or loops may be thrown around the limbs. The encircled part may be so compressed that it is strangulated and the distal portion is destroyed, but it is doubtful whether a constricting cord can ever determine the amputation of a part; for when it sinks through the soft tissues to the bones it experiences a pressure greater than it can exert, and is, therefore, in its turn, destroyed. Thus the neck has been severed to the spinal column, and limbs have been cut through to the bone, but there the process usually stops.

Marginal and Velamentous Insertion of the Cord.—The cord is usually inserted somewhere near the center of the placenta. As the insertion approaches the edge of that organ, the condition receives the name of marginal insertion, or battledore placenta. If the cord should first enter the membranes at some little distance from the placenta, to and from which the vessels, unprotected and more or less separated from one another, pursue their course between the amnion and chorion, a condition known as insertio velamentosa exists. The explanation of such an occurrence is obvious: The allantois is conveyed at first indifferently to any portion of the periphery of the ovum, but as the

placenta begins to be differentiated the embryo, by a movement of rotation, enables the umbilical vessels to pursue a straight course toward their insertion in the placenta. Should the rotation of the fetus be in any way interfered with, or should the newly formed umbilical cord contract adhesions with the amnion

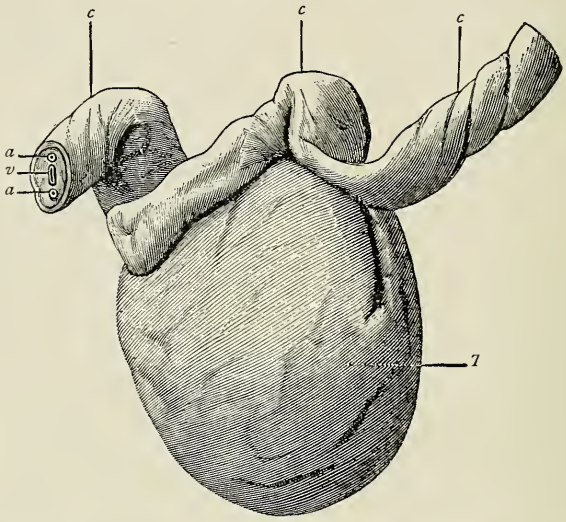


Fig. 105.— Tumor of the cord : *c*, *c*, *c*, Cord ; *T*, tumor ; *a*, *a*, arteries ; *v*, vein (Budin).

or chorion that would prevent the vessels following or complying with the rotation of the embryo, they would naturally enter the membranes opposite the abdominal face of the embryo, or at that point where adhesions arrested their movements. The blood-vessels thus exposed are liable to laceration during labor, usually with a fatal result to the fetus unless delivery is quickly effected.

Umbilical Hernia. — Occasionally children are born with some portion of the abdominal contents protruding into the umbilical cord and covered by nothing but the distended and attenuated amnion. There has been an arrest of development in the abdominal walls, preventing the completion of the arching-over process by which the abdominal cavity is closed.

Cysts of the Cord.—Cystic formations in the cord are due either to an abnormally fluid condition of the mucous tissue or else to a collection of serum in the pedicle of the allantois, which in horses, swine, and cows is found persisting as a vesicle up to the time of birth.

Calcareous degeneration is usually associated with syphilis. The lime may be deposited in the walls of blood-vessels or in the substance of the cord.

Tumors of the Cord.—Tumors of the cord may be cysts, localized hypertrophies, or accumulations of the mucous tissue, hematomata, a small fetus amorphus, as in Budin's case[1] (Fig. 105), and telangiectatic myxosarcomata. The last named should be excised immediately after birth, with the umbilical ring.[2]

THE DECIDUAE.

The explanation which John Hunter gave of the plates published by his brother William[3] was, for a long time, accepted as the true history of the development of the uterine membrane which

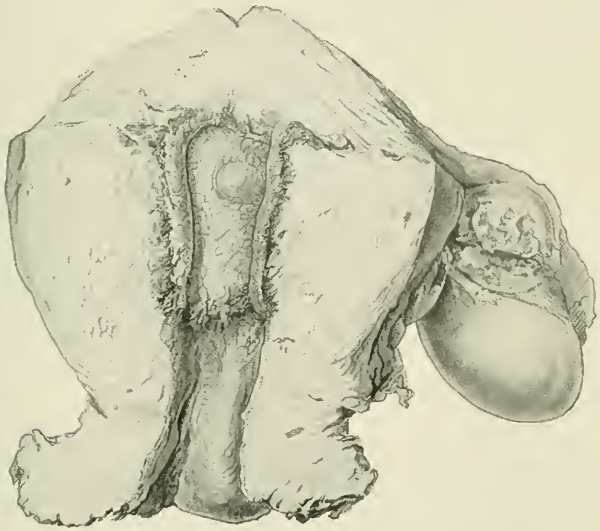


Fig. 106.—Uterus, decidua, and ovum, on the eighth day of pregnancy (Leopold).

envelops the fetus at term. According to the Hunterian theory, the uterus throws out upon its inner surface an inflammatory exudate forming a closed sac whose walls stretched across the openings of the tubes and the os internum cervicis. As the impregnated ovule enters the uterus from one of the tubes it pushes the sac-wall in front of it, but leaves behind it a bare surface, which is soon covered by an exudate similar to the one at first thrown out. That portion of the original membrane which remained atttached to the uterine wall Hunter called the

[1] "Femmes en Couches et Nouveau Nés," Paris, 1897, p. 181.

[2] V. Winckel, "Centralbl. f. Gyn.," 1894, p. 397, reported one case and collected four others.

[3] "Anatomia ut. hum. grav. tab. illustr.," Birm., 1774, table 34.

membrana decidua vera; that portion pushed out in front of the ovule, the membrana reflexa; and that membrane last formed behind the ovule, the membrana serotina. These names have survived until the present day, although modern investigation has robbed them of their original significance. Costi [1] was the first to expose the fallacy of the Hunterian doctrine, and since his time the investigations of Robin, Friedländer, Kundrat, Leopold, Engelmann, Peters, Bryce, Teacher, and others have enabled us to follow the changes that occur in the uterine mucous membrane from the entrance of the impregnated ovule into the uterine cavity until the fetus, with its enveloping membranes, is expelled at term. By the time the fertilized ovum arrives within the uterine cavity the lining mucous membrane of the uterus has become very much thickened,[2] owing to edema and congestion of the upper layers and to hypertrophy of the uterine glands. After the third week the development of decidual cells begins: large cells developed from the connective tissue, in certain areas pressed close together, in others separated by amorphous tissue. The thickening of the membrane is most marked on the anterior and posterior walls, least at the fundus and cornua, and it ceases abruptly above the cervix; the cervical endometrium is unchanged.[3] As a consequence of this thickening the mucous membrane is thrown into folds. In a depression between two of these folds of membrane or on the summit of one of them the ovule imbeds itself when it first enters the uterine cavity. The ovule, being thus imbedded in the uterine mucosa, is inclosed by the arching over of the folds of the membrane, or, as Leopold [4] claims, by their simple approximation owing to the increasing thickness of the mucous membrane. Peters'[5] famous ovum was found imbedded on the apex of one of the folds of uterine mucous membrane, being implanted in the compact layer of cells, and not surrounded completely by the reflexa, but with its internal pole covered by clotted, degenerated blood

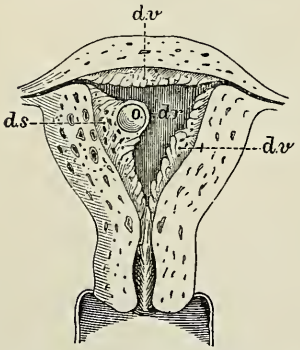


Fig. 107.—Decidua serotina, decidua vera, decidua reflexa, and the ovum: *d.s.*, Decidua serotina; *d.v.*, *d.v.*, decidua vera; *d.r.*, decidua reflexa; *o*, ovum (Schroeder).

[1] "Originie de la Caduque," "Acad. des Sciences," Paris, 4 et 25 Juillet, 1842.

[2] Tenfold according to Engelmann ("Am. Jour. Obstetrics," May, 1875); from the normal 2½ to 3 or 8 mm. according to Pfannenstiel.

[3] Volks reports a case and quotes three others in which there was a decidua formation in the cervix, but it is most exceptional. "Arch. f. Gyn.," Bd. lxix.

[4] "Archiv f. Gyn.," Bd. xi, S. 455.

[5] "Die Einbettung des menschlichen Eies," Leipsic, Wien, 1899.

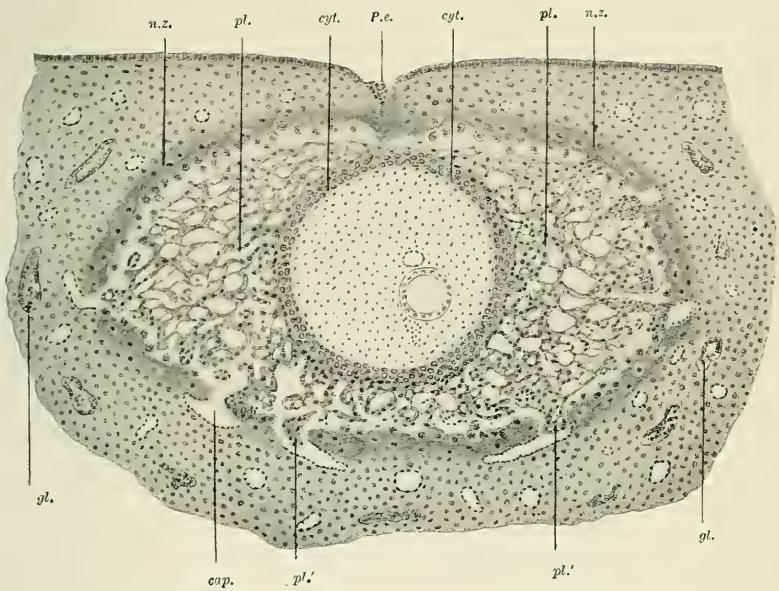


Fig. 108.—Diagram of Teacher-Bryce ovum. (Magnified about 50 diameters.) (T. H. Bryce, Del.): *P.e.*, Point of entrance; *cyt*, cyto-trophoblast; *pl*, plasmodi-trophoblast; *n.z*, necrotic zone of decidua; *gl*, gland; *cap*, capillaries; *pl'*, masses of vacuolating plasmodium invading capillaries. The cavity of the blastocyst is completely filled by mesoblast, and imbedded therein are the amnio-embryonic and entodermic vesicles. The natural proportions of the several parts have been strictly observed (Bryce and Teacher).

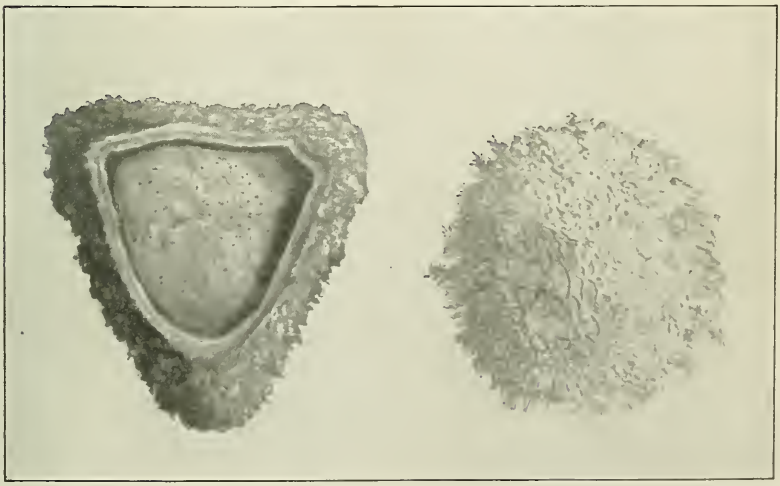


Fig. 109.—The decidua vera and the chorion.

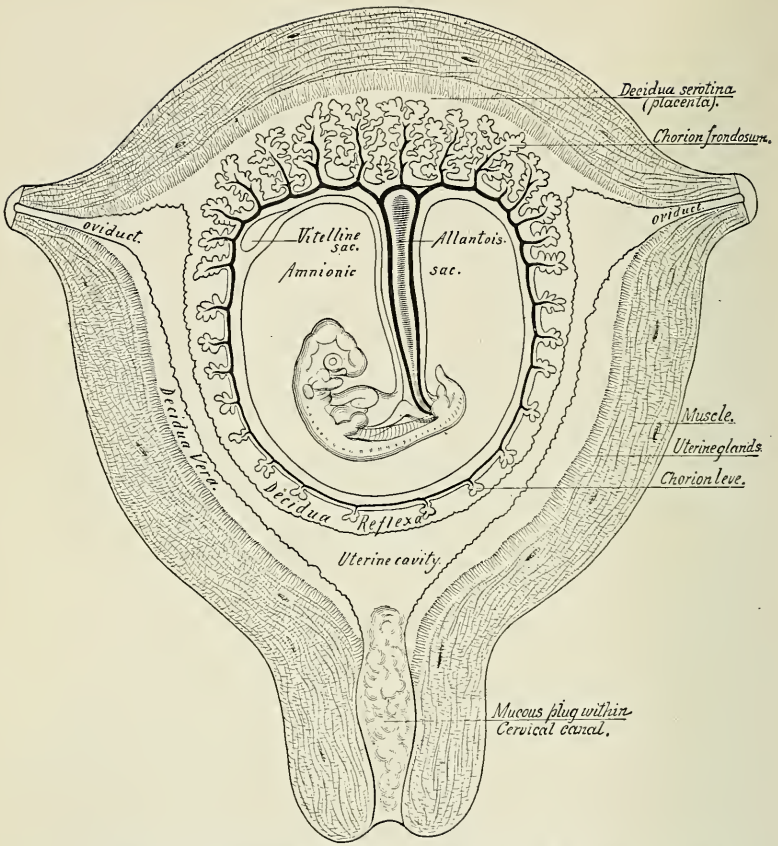


Fig. 110.—Diagram illustrating relations of structures of the human uterus at the end of the seventh week of pregnancy (modified from Allen Thomson).

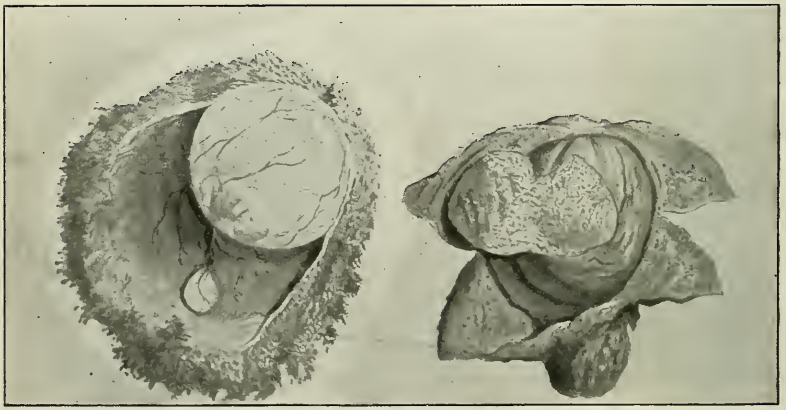


Fig. 111.—Decidua vera, decidua reflexa, the chorion and amnion.

and fetal elements. The ovum of Teacher and Bryce,[1] the youngest and smallest yet observed, was entirely enclosed in its decidual cavity (Fig. 108). A layer of the decidua is therefore pushed out by the growth of the ovum. That portion of the uterine mucous membrane upon which the ovule rests, usually called membrana decidua serotina, might be more properly termed placental or basal decidua, for it is upon this spot that the placenta will be developed; that portion of the membrane which arches over the ovule, called by Hunter the decidua reflexa, is better named the ovular or epichorial decidua; and that portion of the mucous membrane that remains as at first, attached to the uterine wall, the decidua vera of Hunter, is more appropriately spoken of as the uterine decidua. The changes that occur in this last division of the uterine mucous

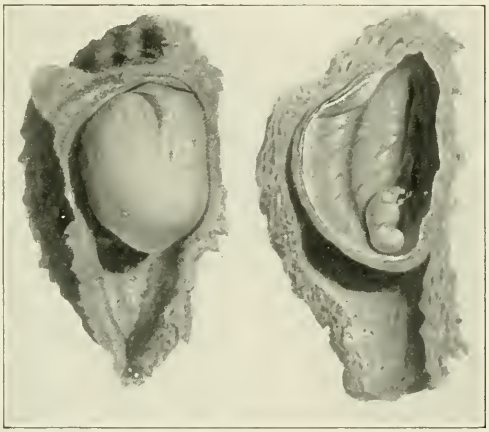


Fig. 112.—Decidua vera and decidua reflexa.

membrane as pregnancy advances are, up to a certain point, only a continuation of the change already noted. The large cells already referred to, the decidual cells of Friedländer, multiply with great rapidity and constitute a thick layer,—the upper portion, or compact layer, of the uterine decidua. The glands which at first send their ducts up through the cellular layer of decidua are at last confined entirely to the deeper portions of the membrane, constituting, finally, what is known as the glandular or spongy layer. In its early stage of development the uterine decidua is richly supplied with blood; the capillary loops spring up luxuriantly into the interglandular spaces; while deeper down, between the glandular layer and the uterine muscle, may be found numerous and extensive blood-sinuses. But when the ovular decidua

[1] "Contributions to the Study of the Early Development and Imbedding of the Human Ovum," Bryce and Teacher, Glasgow, 1908.

comes in contact with the uterine decidua, the blood-vessels are subjected to pressure and the stage of atrophy begins in the endometrium. The blood-vessels disappear; a fatty degeneration is seen in the cellular layer; no trace of epithelium remains in the superficial layer of the membrane, although epithelial cells persist in the glandular layer; and, finally, as labor begins, the uterine decidua separates into two parts, the line of division running through the glandular layer, or between the compact and glandular layers, the latter remaining behind in the uterus to furnish the nucleus of a new mucous membrane, which soon after labor takes the place of that which has been partly cast off. The history of the ovular decidua is one of atrophy almost from the beginning. As the growing ovum pushes out this portion of the uterine mucous membrane upon the pole of the sphere directly opposite the placental decidua, the epithelium of the membrane begins to disappear and the blood-vessels are soon obliterated, so that at the end of the third month, when the ovular comes in contact with the uterine decidua, the former consists of not much more than a single layer of flattened and elongated cells. The development of the placental decidua has been described with that of the placenta.

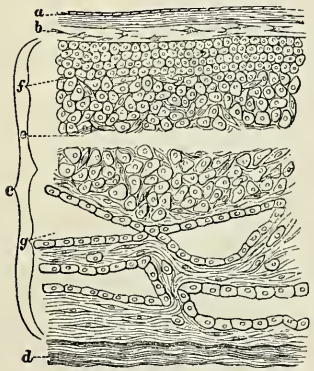


Fig. 113.—Diagrammatic representation of a section through the membranes: *a*, Amnion; *b*, chorion; *c*, decidua; *f*, compact layer; *e*, line of separation, which Friedländer incorrectly put in the compact layer; it is really in the glandular layer; *g*, spongy or glandular layer; *d*, muscularis (Friedländer).

Diseases of the Deciduæ.—The decidual mucous membrane of the pregnant uterus may be the seat of many of the diseases that attack the endometrium of the non-gravid uterus. In the former state, however, diseased conditions often manifest themselves in exaggerated forms, owing to the enormous hypertrophy of the mucous membrane. Moreover, in consequence of its relation to the fetus, a disease of the decidual endometrium has more serious consequences than a similar affection of the non-gravid uterus.

Diffuse Hyperplastic Inflammation of the Decidual Endometrium.—The cause is usually a prœxisting endometritis. But the death of the embryo or some disease of the ovum may prove irritating enough to incite the mucous membrane of the uterus, previously healthy, to overgrowth. As the constituent parts of the mucous membrane are more or less affected, the manifestations of the disease vary.

Diffuse hyperplasia of the decidual endometrium is an exaggeration of the hyperplasia that occurs normally in the early months of pregnancy. Abortion usually results, either on account of the hemorrhages into the mucous membrane, separating it from the uterine wall, or owing to the death of the embryo, from which all nutrition has been diverted to supply the greater needs of the rapidly growing decidua. In such cases the embryo may be absorbed and the deciduæ afterward cast off as an empty sac with greatly thickened walls, forming one variety of the so-called fleshy moles.[1] Or, the embryo may be destroyed in consequence of the hemorrhages into the hypertrophied decidua, the blood bursting its way through all the membranes and occupying the cavity of the ovum, as well as surrounding it externally.[2]

If the hypertrophy of the decidua is gradual, the fetus may not be expelled before it becomes viable, or even until the normal end of pregnancy.[3] The structure of the hypertrophied decidua is usually only an exaggeration of what may be seen in the decidua of early pregnancy. There is a great multiplication of the decidual cells, some of which are elongated and seem to be transforming themselves into connective tissue; the blood-sinuses are much enlarged in the deeper portions of the membrane, and there is usually an abundance of connective tissue.

Polypoid Endometritis.—The decidua may display upon the uterine surface projections or excrescences where the hyperplastic process seems to have been exaggerated over a limited area. Such cases have been described by Hofe[4] and Schroeder.[5] To the most advanced type of this polypoid condition of the uterine mucous membrane Virchow[6] first gave the name of endometritis decidualis polyposa or tuberosa.

Villus-like projections stand out from the mucous membrane to the height of half an inch or more, smooth of surface and very vascular. In the intervals between the projections are the openings of the uterine glands, which are not found on the polypoid elevations. The whole membrane is greatly thickened, owing to the hypertrophy of the connective-tissue elements and to an increase in the decidual cells, which contain nuclei of enormous size. The connective tissue forms fibrous bands constricting the openings of the glands, as well as the blood-vessels in the diseased membrane; and yet the whole decidua

[1] Schroeder, "Lehrbuch."

[2] Priestley, *loc. cit.*, p. 28, who quotes Gendrin, Hegar, and Westmacott.

[3] I have seen a living fetus, delivered at the sixth month, from a woman who three days afterward expelled a piece of decidua 1 cm. thick and measuring 6 cm. in diameter.

[4] D. I. Marburg, 1869: "Ueber Hyperplasie der Decidua."

[5] *Op. cit.*, p. 402. [6] "Die Krankh. Geschw.," Bd. ii, S. 478.

is exceedingly vascular. In Virchow's case there was a syphilitic history, and, therefore, he ascribes the disease to

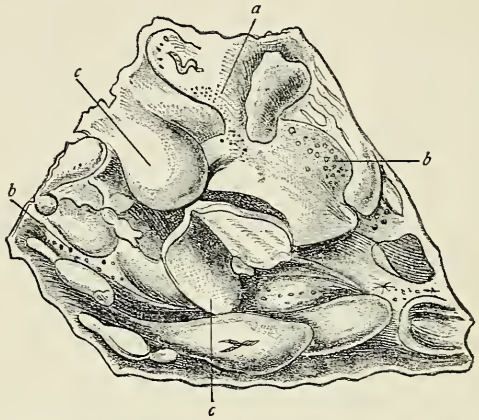


Fig. 114.—Polypoid endometritis: *a*, Fine apertures of the glands; *b,b*, larger apertures of the glands; *c,c*, protuberances or polypi.

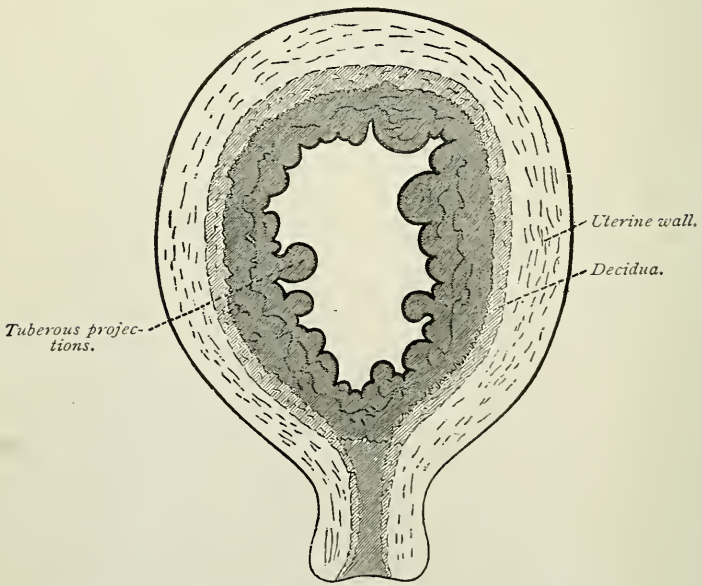


Fig. 115.—Tuberous subchorial hematomata of the decidua (Walther).

syphilis; in other instances no cause whatever could be discovered, but often this disease, as well as other affections of the decidua, depends upon a preëxisting chronic endo-

metritis. It is a disease of young ova, and frequently the chorion villi implanted in the diseased mucous membrane are in a condition of mucous degeneration.[1] In all the cases hitherto described the ovum has been expelled between the second and the fourth months of pregnancy (Schroeder). Polypoid endometritis is closely simulated by blood extravasations

Fig. 116.—Tuberous subchorial hematomata of the decidua (author's case).

between the decidua and the chorion, as shown in figures 115[2] and 116.

Catarrhal Endometritis.—A chronic inflammation of the decidual endometrium may affect chiefly the glands. There is a hypersecretion of a thin, watery mucus, which collects between the chorion and deciduæ, and is suddenly expelled, after a rupture of the ovular decidua, in the later months of pregnancy. This occurrence gives rise to sudden gushes of fluid from the vagina, which may reach a pint in quantity. Afterward the fluid may dribble away for a considerable length of time without affecting seriously the course of pregnancy, or else, accumulating once more

[1] Müller, "Bau der Molen," 1867.

[2] Walther, "Centralbl. f. Gyn.," 1892, p. 707.

in considerable quantities, it may again be suddenly expelled. Two or three repetitions of the accumulation of fluid and its sudden discharge usually excite the uterus to muscular action, and terminate pregnancy. This affection occurs more frequently in multiparæ than in primiparæ, and seems to depend in some cases upon hydremia. The mucous discharge is one of the forms of hydrorrhœa gravidarum.

Cystic Endometritis. — If there is a hypersecretion of the uterine glands, and the escape of the fluid contained in the glandular spaces is prevented, a condition results, found only in very young ova, known as cystic endometritis. It is not improbable that this condition might be found quite constantly in the earlier stages of the chronic hyperplastic decidual endometritis already described, the glands being destroyed and obliterated as the disease advances. A section of mucous membrane affected with cystic disease presents a cavernous appearance, due to numerous small cysts. Their connection with the uterine glands may be demonstrated by the relation between the cysts and the ducts of the glands.[1] About the cysts the decidua is hypertrophied, presenting the overdevelopment of connective tissue, increase of decidual cells, and embryonal tissue already described.[2]

The prognosis of all these chronic affections of the decidual endometrium is unfavorable for the fetus and for the mother. There is danger to the fetus from hemorrhages, which bring about separation of the membranes, or which, bursting through all the fetal envelopes, overwhelm the embryo with blood; there may be diversion of nutriment from the embryo to the overgrown decidua, and the irritation of the chronic inflammation or of a hemorrhage may result in excitation of muscular action upon the part of the uterus, which ends in the expulsion of the ovum. The possible loss of blood during pregnancy, and the retention of fragments of decidua owing to adhesive inflammation after the ovum is expelled, are not without their effect upon the mother.

The treatment of this condition during pregnancy is impossible. Its prevention may be attempted, however, by a curettage before impregnation occurs again.

Acute Inflammation of the Deciduæ.—Acute inflammation of the decidual membranes may develop in the course of cholera and other infectious diseases, especially the exanthemata, in consequence of unsuccessful attempts to induce abortion, or as a result of traumatism.

[1] Leopold, "Gesellsch. f. Geburtsh.," Leipsic, Feb., 1878.

[2] See Breus, "Ueber cystose Degeneration der Decidua Vera," "Archiv f. Gyn.," Bd. xix, S. 483.

Hemorrhagic decidual endometritis is the name given to the condition of the mucous membrane found in two cases of cholera,[1] and, no doubt, present in other grave infectious diseases. The decidua is thickened, of a dark, purplish hue, and presents throughout its substance numerous extravasations of blood.

Exanthematous Decidual Endometritis.—Klotz,[2] in eleven cases of measles in pregnancy, noted in nine a premature expulsion of the fetus, the time at which the expulsive efforts began coinciding with the appearance of the rash. In these cases, according to Klotz, the uterine action is excited by the occurrence of an exanthema upon the uterine mucous membrane, highly irritating in its action, just as the photophobia, the coryza, the bronchitis, and the vesical tenesmus of measles indicate an irritated condition of the mucous membranes of the eyes, nose, lungs, and bladder. Salus[3] in thirteen cases saw the same tendency to miscarriage. It is probable that this condition of the uterine mucous membrane accounts for the abortions or premature labors that often occur when pregnant women are attacked by any of the eruptive fevers.

Purulent and Microbic Decidual Endometritis.—Donat[4] has described a case of purulent endometritis in pregnancy. A woman expelled at term a placenta about the periphery of which could be seen masses of decidua infiltrated with pus. The amnion and chorion were both thickened and opaque, and between them was an accumulation of purulent fluid. It was suspected that the suppuration of the decidua was the result of unsuccessful attempts on the part of the woman to bring on a miscarriage.

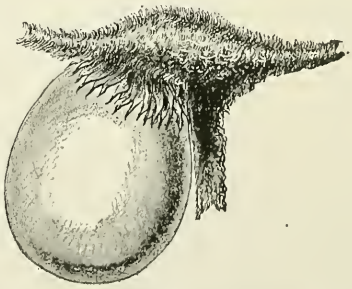


Fig. 117.—Atrophy of the decidua, external surface of the vera (Duncan).

Tuberculous endometritis[5] in pregnant women has been reported by several observers. In three instances pregnancy went to term in spite of the caseous degeneration of the mucosa. In one case rupture of the uterus occurred at the third month.

Atrophy of the Deciduæ.—The deciduæ, instead of undergoing inflammatory and hyperplastic changes, may rarely atrophy.

[1] Slavjansky, "Archiv f. Gyn.," Bd. iv, S. 285.

[2] "Archiv f. Gyn.," Bd. xxix, S. 448.

[3] "Prager med. Wochenschr.," 1899, No. 7.

[4] "Archiv f. Gyn.," Bd. xxiv.

[5] Vineberg, "American Gynecology," October, 1903.

This process has been described by Hegar,[1] Matthews Duncan,[2] Spiegelberg,[3] and Priestley.[4] The uterine, ovular, or placental deciduæ may singly or conjointly be the seat of atrophy, resulting in the attachment of the ovum by a slender pedicle to the uterine wall, or in its rupture and the discharge of its contents from the uterus. As a result of the stretching of the pedicle in cases of placental atrophy, the ovum may be pushed downward by the uterine contractions until it rests in great part within the cervical canal. This condition constitutes the cervical pregnancy of Rokitansky.

[1] "Monatsh. f. Geburtsh. u. Fr.," Bd. xxi; Supplem., pp. 11, 19, 1863.

[2] "Researches in Obstetrics," p. 295, 1868.

[3] "Lehrbuch," p. 328.

[4] *Op. cit.*

CHAPTER V.

The Diseases of the Fetus.

FETAL mortality exceeds that of any other period of life. It has been estimated that for every four or five labors there has occurred one abortion, and if to this number be added the still-births in which the death of the fetus was not due to an accident in labor, the proportion of fetal deaths to living births is very large. In addition to the diseases having a fatal termination, there are others running their course wholly or in part during intra-uterine life and ending in recovery; so that the list of fetal diseases is an extensive one.

The present chapter treats of the diseases of the fetal organism itself, of weakness dependent upon defects in the paternal elements entering into the composition of the embryo, and of maternal conditions which are incompatible with the healthy development or with the continued existence of the product of conception.

Fetal Syphilis.—First in importance of all the diseases of intra-uterine life, fetal syphilis deserves extended notice. According to Ruge,[1] eighty-three per cent. of repeated premature and still-births have their cause in syphilis of one or both of the parents. Of 657 pregnancies in syphilitic women collected by Charpentier,[2] thirty-five per cent. ended in abortion, and of the children that went to term a large number were still-born. Of 100 conceptions in syphilitic women, only seven children were alive a year later.[3]

The syphilitic infection of the fetus is due to syphilis in the mother or father before conception or to syphilitic infection of the mother during pregnancy.

Syphilis may be transmitted from a syphilitic father direct to the embryo without infection of the mother. As the fetus grows and the syphilitic poison develops with its growth, the mother becomes mildly infected in her turn directly from the fetus through the uteroplacental circulation.[4] The longer

[1] See Lomer, "Zeitschr. f. Geburtsh.," Bd. x, p. 189.

[2] "Traité pratique des Accouchements."

[3] Pileur, "Bull. de la Soc. d'Obst. et de Gyn.," Paris, Dec. 13, 1888.

[4] See Tarnier et Budin, *op. cit.*; Priestley, *loc. cit.*; J. Hutchinson, "British Med. Jour.," Feb., 1886, p. 239; Harvey, "Fetus in Utero," 1886; G. S. West, "Am. Jour. Obstetrics," 1885, p. 182.

the time since the acquisition of the disease by either parent, the less likelihood there is of syphilis in the embryo; but the limit of safety has not yet been discovered. According to Fournier,[1] four years is the maximum of time that syphilis can remain latent, but Lomer[2] reports the birth of a syphilitic infant ten years after the first infection of the father, and Kassowitz[3] records a latent syphilis of twelve years' duration.

Vajda[4] and Hutchinson[5] describe cases in which pregnant women were infected near term and gave birth to syphilitic children. Neumann[6] has published observations of 20 women who were infected with syphilis during pregnancy; 5 of this number gave birth to syphilitic children, and of these 5 2 were infected at the fourth and 1 each at the third, seventh, and eighth months. Hirigoyen[7] has reported 12 cases in which the mother contracted syphilis during the first four months of pregnancy; all the children were still-born; in cases of infection from the fourth to the sixth month, about half the children were still-born; and in 7 cases of infection during the last three months of pregnancy there were 4 still-births.[8]

The manifestations of fetal syphilis are bullous eruptions of the skin, condylomata, inflammations of the mucous and serous membranes, gummatous and miliary deposits, morbid growth of connective tissue in the brain, lungs, pancreas, kidneys, liver, spleen, the muscular system, the coats of the intestines and walls of the blood-vessels, and a characteristic osteitis and osteochondritis.

The prognosis is unfavorable. If the fetus is not destroyed before it is viable, it is often retarded in development, feeble, and diseased. There is an enlarged abdomen, due to ascites, to enlarged liver or spleen; nodes in the lungs or in the bronchial glands; hydrocephalus; separation of the epiphyses of the long bones from the diaphyses; extensive pemphigoid eruptions on the skin, or, possibly, the fetus is deformed or monstrous in appearance. There are cases, however, in which the course of intra-uterine life does not seem to be influenced in the slightest degree by syphilis. The children are born apparently healthy and well developed, but exhibit unmistakable signs of their hereditary taint within the first few weeks after birth.

[1] "Syphilis et Marriage."

[2] "Zeitschr. f. Geburtsh.," Bd. x, 94.

[3] Stricker's "Jahrb.," 1875, p. 476.

[4] "Centralbl. f. Gyn.," 1880, p. 360.

[5] "British Med. Jour.," 1886, i, 239.

[6] "Wien. med. Presse," 29, 30, 1885.

[7] Abstract in "N. Y. Med. Record," April 12, 1887.

[8] The author has seen a woman impregnated by a healthy man, but infected with syphilis in the third month of pregnancy, give birth to a syphilitic child.

PLATE 5.

Head of femur removed from a fetus expelled, dead and macerated, at the seventh month. The liver weighed one-tenth of the body-weight; the spleen, one-forty-eighth. The mother was infected with syphilis one year before.

Diagnosis of Fetal Syphilis.—The infection of the fetus may be inferred with reasonable certainty if either parent had acquired syphilis at a date not too remote from the procreation. If a woman acquires a chancre during pregnancy, the possibility of the disease attacking the fetus must not be overlooked. A sign of syphilis in the fetus is occasionally furnished by the symptoms of secondary syphilis in the mother without a trace anywhere of a primary sore. In such cases the disease may have been transmitted from fetus to mother.

Often the signs of fetal syphilis can be looked for only in the fetus itself, after its expulsion from the uterus, and much may depend upon a correct diagnosis. The parents' history, from ignorance or design, may be entirely negative. The child may be born with no distinctive mark upon its body. If it is living, the coryza and characteristic eruptions during the first few weeks usually point clearly to the hereditary taint. If it has pemphigus the spirochæta pallida may be found in the fluid from the blebs. If the child is dead, the diagnosis can easily be made.

If the practitioner is a trained pathologist, the detection of syphilis is easy. The bullous eruption on the skin, the condylomata and inflammations of the mucous membranes and serous membranes, the gummatous deposits and the morbid growth of connective tissue in the brain, lungs, pancreas, kidney, liver, spleen, in the coats of the intestines and walls of the blood-vessels, and a characteristic osteochondritis, demonstrate the character of the disease. The spirochæta pallida may be found in the fetal tissues, the umbilical cord, and the placenta (p. 129). The general practitioner often observes cases of repeated fetal death the cause of which is obscure, although suspicion naturally rests upon syphilis. Thanks to the investigations of Wegner,[1] Ruge,[2] Lomer,[3] and others, syphilis can be recognized in the fetus by a few signs easily found, perfectly reliable, and requiring for their detection no special training in the methods of pathological research. Wegner was the first to call attention to a curious condition of the dividing line between diaphysis and epiphysis of the long bones of a syphilitic infant. Instead of a sharp, regular, delicate line, formed by the immediate apposition of cartilage to bone, as in a healthy fetus, there is seen in syphilis a broad jagged yellow line[4] (Plate 5). A microscopic study of this portion of the bone shows that there has been a premature attempt at ossi-

[1] Virchow's "Archiv," Bd. i, S. 305.

[2] "Zeit. f. Geburtsh.," Bd. i. [3] *Ibid.*, Bd. x.

[4] To discover Wegner's sign, an incision should be made over the trochanter, as though for excision of the head of the femur. The end of the thigh-bone is turned out after cutting its ligaments, and a median section of the epiphysis and diaphysis of the bone is made with a strong cartilage-knife.

fication, which has ended in necrosis, fatty degeneration, and suppuration.

For more than a year I carefully looked for this sign in every case of unmistakable fetal syphilis that occurred in the Philadelphia and Maternity Hospitals, and never failed to find it, while in doubtful cases it proved a valuable aid to a correct diagnosis. In the Frauenklinik, at Berlin,[1] this sign was also carefully investigated, with a result wholly favorable to its distinctive character.[2]

According to Ruge,[3] the liver of a healthy infant should constitute about $\frac{1}{30}$ part of the body-weight. In syphilitic infants this proportion is much exceeded, the liver reaching, in extreme cases, $\frac{1}{8}$ of the total body-weight. The spleen, too, usually $\frac{1}{300}$ of the body-weight, is much enlarged in syphilis. Upon these three signs,—the yellow line between epiphysis and diaphysis, the increased weight of liver, and increased weight of spleen,—all easily discovered, the diagnosis of syphilis may rest with reasonable certainty. Valuable indications of syphilis are also found in the lungs[4]: an interstitial overgrowth; the presence of gummata; a peculiar catarrhal inflammation, resulting in what is called white pneumonia. The interstitial overgrowth is the most common. The newly formed connective tissue about the blood-vessels and alveoli gives the lungs greater weight and more solidity than usual; their color is often dark red; if the infant has breathed for a short time after birth, the lungs will not float buoyantly, although they do not usually sink outright. The alveoli are much encroached upon by the interstitial thickening; lung-expansion and adequate respiration are impossible. The catarrhal pneumonia due to syphilis is rare. The lungs are large and heavy; they completely fill the thoracic cavity and bear upon their external surface the imprint of the ribs; in color they are yellowish-white, from fatty degeneration. The alveoli are filled with desquamated epithelial cells. This condition is incompatible with extrauterine life: the infant never breathes.

The treatment of fetal syphilis during pregnancy is a thorough course of antisyphilitic treatment in the mother. If the fetus derives its syphilis from one parent alone, treatment of the healthy individual before impregnation is superfluous; but in case of doubt it is wise, in the preventive treatment of fetal

[1] Lomer, *loc. cit.*

[2] Zweifel thus describes the progress of the disease: "There is formed, in a certain region of the cartilage, granulation-tissue insufficiently supplied with blood-vessels and ill-nourished. There results necrosis of this tissue, with an attempt at exfoliation and accompanying suppuration."

[3] *Loc. cit.*

[4] For an exceedingly interesting paper on this subject see Heller, "Die Lungenerkrankungen bei angeborener Syphilis," "Deutsch. Archiv f. klin. Med.," Bd. xlii, S. 159.

syphilis, to administer to both man and woman the appropriate remedies.

Should a pregnant woman come under the observation of a physician with the history that she had had syphilis, that she was with child by a syphilitic man, although healthy herself, or that she had acquired a chancre subsequent to conception, she should receive mercury and iodid of potassium. I prefer mercurial ointment inunctions daily, and about 15 gr. (1 gm.) of iodid of potassium three times a day, after meals, in milk, during the whole duration of pregnancy. Under this treatment I have seen women who had given birth to a succession of still-born syphilitic fetuses bear living children perfect in health and development, without a trace in after life of hereditary taint.

Other Infectious Diseases of the Fetus.—As the infectious diseases are dependent upon the entrance of bacteria into the system for their characteristic symptoms, it is impossible that they should directly affect the fetus *in utero*, unless pathogenic micro-organisms are able to pass from the maternal blood through the uteroplacental septum into the fetal portion of the placenta.

It appears from experiments extending over the last fifty years with various bacteria that micro-organisms may, but do not always, pass from mother to fetus. Moreover, there is a long list of diseases due to the presence of specific micro-organisms, which have in well-authenticated cases undoubtedly attacked the fetus *in utero*.

Variola.—Many cases are recorded in which a child marked with pustules was born of a mother who had had variola during pregnancy. But the susceptibility of the fetus to the disease varies. In the majority of cases it is not infected. On the contrary, the mother may have only varioloid and yet the child be born with the marks of small-pox ;[1] or the mother, having been exposed to the contagion of small-pox, but having shown no sign of the disease, may give birth to a child covered with pustules.[2] Again, it has been noted that, of twins, one or both of the children may be affected.[3] The fact that small-pox can attack the fetus has led many observers to test the possibility of an intra-uterine vaccination. Behm[4] vaccinated 33 women, and of their children 25 were successfully vaccinated after birth. Wolff[5] says that he has repeatedly vaccinated pregnant women, and has never failed to vaccinate successfully their offspring. Ridgen[6] reports 8 cases of small-pox occurring in pregnant

[1] Charcot, "Comptes rendus de la Société de Biologie," 1851, p. 39, and 1853, p. 88; Chaigneau, "Thèse de Paris," 1847; Chantreuil, "Gaz. des Hôpitaux," 1870.

[2] Laurent, "Lyon Médicale," June 15, 1884.

[3] "Obstet. Trans.," London, vol. iii, p. 173.

[4] "Zeitschr. f. Geburt.," Bd. vii, p. 1.

[5] Virchow's "Archiv," Bd. cv, p. 192.

[6] "British Med. Jour.," 1877, i, p. 229.

women, in whose children, born alive, a subsequent vaccination "took." On the other hand, Desnos[1] and Chambrelent[2] each relate a case in which vaccination was several times unsuccessfully performed upon children whose mothers had shortly before their delivery recovered from an attack of small-pox. Chambrelent, moreover, vaccinated 7 pregnant women, but of their children he was able successfully to vaccinate only 3. The fetus, therefore, in exceptional cases acquires immunity from small-pox by the vaccination of its mother.

Measles.—The transmission of measles from mother to fetus is rare. Thomas[3] was able to collect 6 cases from medical literature. There are also recorded cases of measles appearing in the first few days of extra-uterine life, making it probable, from the short period of incubation, that infection had occurred *in utero.*

Scarlatina.—Leale[4] reports the birth of a boy at the beginning of a well-marked attack of scarlet fever in the mother, which she had contracted from an older child. The new-born infant presented a dark, congested, red hue and a characteristic raspberry tongue. The eruption lasted seven days and desquamation began on the tenth day, when albuminuria and general anasarca indicated a desquamative nephritis. The child recovered. Other cases are recorded by Hüter, Meynet, Asmus, Baillou, Tourtual, Gregory, and Stichel. Saffin[5] has reported an interesting case of intra-uterine scarlet fever: A woman, who had had scarlet fever in childhood, was nursing her child through the disease, while she herself was in the last month of pregnancy. She was apparently not infected, but complained of a bad sore throat. Two weeks later she was delivered of a male child with a typical scarlet rash upon it; the disease ran a course of nine days, with desquamation in large and small flakes, beginning on the fifth day. The infant's temperature ranged from 100° to 104° F.; it recovered.[6]

Erysipelas.—Kaltenbach,[7] Runge,[8] and Stratz[9] have reported cases apparently of fetal erysipelas. Lebedeff[10] reports

[1] Société méd. des Hôpitaux, 1871 (see Tarnier et Budin, *op. cit.*, p. 13).

[2] *Loc. cit.*, p. 385.

[3] Ziemssen's "Handbook," vol. ii, p. 50 (see also Underhill, "Obstet. Jour., Great Britain and Ireland," 1880, p. 285, and MacDonald, "Edin. Med. Jour.," 1884–85, 699).

[4] "Medical News," 1884, p. 636.

[5] "New York Med. Record," April 24, 1886.

[6] For full bibliography see Ballantyne and Milligan, "Edinb. Med. Jour.," July, 1893.

[7] "Centralblatt f. Gyn.," No. 44, 1884.

[8] "Centralblatt f. Gyn.," No. 48, 1884.

[9] "Centralblatt f. Gyn.," ix, 213.

[10] "Zeitschr. f. Geburt.," xii, 2, p. 321.

the following case : The child of a woman delivered at the seventh month in the midst of an attack of erysipelas presented alternate patches of red and white on its skin at birth ; it lived ten minutes ; after death streptococci were found in the subcutaneous adipose tissue, were cultivated, and rabbits inoculated with the cultures acquired the disease. No microbes, however, were found in the placenta or cord. Lebedeff believes that the streptococci entered the placenta through a villus deprived of epithelium.

Malaria.—Behrmann reports two cases of intra-uterine infection in which the disease manifested itself directly after birth.

Malaria in the mother retards the growth and development of the fetus. Bompiani [1] says that children born of malarial mothers very rarely reach 3250 gm. (7.17 lbs.) in weight or 50 cm. (19.7 in.) in length, and Negri [2] observed 34 cases in pregnant women, of which 18 per cent. terminated by premature expulsion of the fetus. Quinin in large doses to the mother is indicated. "Quinin in this condition is the best prophylactic treatment against abortion or premature labor" (Tarnier).

Economos [3] has found the plasmodium in 6 out of 7 newborn infants whose mothers had malaria.

Tuberculosis.—In view of the large number of tuberculous women who become pregnant, it is an extraordinary fact that the direct transmission of the disease from the mother to the fetus is an extremely rare occurrence. Runge [4] infected a number of pregnant guinea-pigs with tuberculosis, but invariably failed to find the characteristic bacilli in the fetal tissues or placenta. Ballinger, Davaine, Brauell, and Wolff have denied the existence of congenital tuberculosis, and Jani's observations have already been noticed. But Demme once found tubercle bacilli in the macerated fetus of a tuberculous woman, and Johne [5] discovered tubercles in a still-born calf, in which he found the bacilli.[6] Runge has demonstrated tubercle bacilli in the placenta and in the maternal decidua. Tubercle bacilli have been demonstrated in the fetal portion of the placenta by Lehman, Schmorl, Kockel, Auché, and Chambrelent. While, therefore, there is a remote possibility of the passage of tubercle bacilli from mother to fetus, it is an exceptional occurrence.[7]

[1] "Annal. di Obstet.," vi, 42, 46, 1884. [2] "Annal. di Obstet.," viii, p. 277.

[3] "Soc. d'Obstét. de Paris," 25, February, 1907.

[4] Quoted by Ott, *loc. cit*, [5] Quoted by Wolff, *loc. cit.*

[6] Ravenel reported a similar case to the Philadelphia Pathological Society, Feb. 23, 1899.

[7] See A. S. Warthin, "Ectopic Gestation; Tuberculosis of Tubes, Placenta, and Fetus," "Med. News," Sept. 19, 1896; Birch-Hirschfeld, "Beitr. z. path. Anat. u. zur allgem. Path.," 1891; "Archiv f. Gyn.," Bd. xliii, H. 1, p. 162. Hauser, "Deutsch. Arch. f. klin. Med.," 1898, vol. lxi, p. 221, 18 cases. Gottschalk, "Arch. f. Gyn.," Bd. lxx, H. 1; "Arch. f. Gyn.," Bd. lxviii.

Septicemia.—The possibility of the transmission of septic micro-organisms from mother to fetus has been denied by many, but the antenatal infection of the fetus has been demonstrated by Koubassoff, Chambrelent, Pyle, Mars, H. von Holst, and others.

Cholera.—Tarnier[1] says that there is nothing to justify the belief that cholera affects directly the fetus; and Queirel[2] asserts that it is doubtful whether cholera can be conveyed to it, but early abortion is the rule, and if the child should be born near or at term it dies in a few days.

Typhoid fever is usually disastrous to the fetus, resulting in its premature expulsion in about sixty-five per cent. of the cases.[3] The elevation of the temperature, the alteration of the blood, and the respiratory embarrassment are considered the causes of the abortion or premature labor. But that the disease can affect the fetus itself has been shown by Neuhaus,[4] who found the specific bacilli of typhoid fever in the lungs, spleen, and kidneys of a fetus expelled at the fourth month from a woman who was convalescing after a prolonged attack of the disease. Both bacilli and the Widal reaction have been found in the fetal blood (Lynch).

In 30 cases collected by Hicks and Frank the bacilli were found in the fetal blood in 15.[5]

Articular Rheumatism.—There are two instances on record of the transmission of the disease from mother to fetus, reported by Pocock[6] and Schäffer.[7] In each a woman affected with articular rheumatism at the end of pregnancy gave birth to a child presenting, in one case at once, in the other at the end of three days, all the symptoms of the disease.

Recurrent Fever.—Albrecht[8] has described three cases of congenital recurrent fever, and in the blood of one fetus he discovered the spirilla.

Yellow Fever.—Bemiss,[9] of New Orleans, says: "The pregnant woman being attacked by yellow fever and recovering without miscarriage, immunity from future attacks is conferred upon the offspring contained in the womb during the attack."

[1] *Loc. cit.* [2] "Nouv. Archiv d'Obstét. et de Gynec.," April 25, 1887, p. 1.

[3] Duguyot, "Thèse de Paris," 1879. Sacquin's statistics show interruption of pregnancy in 199 out of 310 cases. "Thèse de Nancy," 1885.

[4] "Berlin. klin. Wochens.," 1886, p. 389. See also Speier, "Zur Kasuistik des placentaren Ueberganges der Typhusbacillen von der Mutter auf die Frucht," Inaug. Diss., Breslau, 1896. Lynch, "Placental Transmission, with the Report of a Case during Typhoid Fever," "John Hopkins Hospital Reports," vol. x, Nos. 3, 4, and 5. Exhaustive bibliography.

[5] London "Lancet," Dec. 30, 1905.

[6] London "Lancet," 1882, ii. p. 804. [7] "Berlin. klin. Wochens.," 1886, S. 79.

[8] "St. Petersburg. med. Wochens.," 1880, No. 18, and 1884, p. 129.

[9] See Parvin's "Obstetrics," p. 222.

Pneumonia.—The placental transmission of pneumococci has been demonstrated in a number of instances, resulting in a pneumococcus septicemia if the lung has not expanded or in pneumonia if it has.[1]

Non-infectious Diseases of the Fetus.—The infectious diseases are transmitted from mother to fetus. The non-infectious diseases have an independent origin in the latter. It appears occasionally, however, as if a non-infectious disease occurring at the same time in mother and fetus were transmitted from one to the other.

Some of the diseases of the fetus owe their origin to a vitiated condition of the maternal blood, to an inherent weakness in the building material of the fetus, as in cases of chronic systemic affections of either parent, or to a perverted nervous action in the mother. Others are inexplicable. Many of the fetal diseases are interesting only to the pathologist, but a few deserve some notice here.

Rachitis; Chondrodystrophia Fœtalis; Achondroplasia.—Schorlau[2] collected the records of forty-three cases of congenital rachitis, and added to the number two of his own; while Gräfe[3] mentions the cases that have been described by Sandefort, Winckler, Schultz, Virchow, Kehm, and Fischer; Fehling[4] and Hennig[5] have also described specimens of fetal rachitis.

Antenatal rachitis depends upon malnutrition; but the fact that the mother has at some time had rachitis herself, as evidenced by the shape of her pelvis, does not predispose the fetus to the same affection. The appearance of a rachitic fetus is distinctive. It has an enlarged head, perhaps hydrocephalic; gaping sutures and fontanels, a "chicken" breast and a much distended abdomen; the extremities are short, thick, and often bent at an angle, or curved, and the joints are large and prominent. The spine is often curved either laterally or anteroposteriorly.[6] The bones are either abnormally hard and firm or so brittle that they are fractured by the slightest force. This condition of the bones in rachitis may be simulated by the arrest of bony development in cases of sporadic fetal cretinism.[7] Bidder and Müller have described bone diseases in the fetus which appear to be varieties of rachitis.

[1] Levy, "Arch. f. experiment. Path." Bd. xxvi, and Netter, "Comp. rend. Biol.," May 15, 1889.

[2] "Monatschr. f. Geburtsh.," Bd. xxx, S. 401.

[3] "Arch. f. Gyn.," Bd. viii, S. 500.

[4] *Ibid.*, Bd. x.

[5] "Transactions of Meeting of German Naturalists and Physicians," Berlin, 1886.

[6] Gräfe, *loc. cit.*

[7] Virchow's "Archiv," Bd. c, S. 256.

Chondrodystrophia fœtalis or *achondroplasia* depends upon an arrest of development in the epiphyses, with a consequent shortening of the long bones of the extremities. The appearance of the

Fig. 118.—Chondrodystrophia fœtalis.

fetus suggests rachitis, but an examination of the skeleton establishes the diagnosis.[1]

Anasarca.—General anasarca of the fetus is occasionally seen. The distention of the fetal skin may reach such dimensions that the expulsion of the child is exceedingly difficult.[2] Such children are, however, usually born prematurely from the fourth to the eighth month, and are, as a rule, still-born, although cases are recorded in which they lived for a short time after birth. The causes of this condition must be various. It has been attributed to anasarca of the mother, to syphilis, to absence of the thoracic duct;[3] in one instance to leukemia of the fetus,[4] in another to obstruction of the umbilical vein.[5] The serous infiltration of the skin is usually accompanied by a collection of fluid in the abdominal and pleural cavities, and the membranes and placenta are often markedly edematous.

[1] "Handbuch d. Geburtsh.," F. v. Winckel, II., 2, 1905.

[2] Keiller, "Edinburgh Med. and Surg. Jour.," April, 1855.

[3] "The Diseases of the Fetus," Ballantyne, Edinburgh, 1895, 2 vols. Complete bibliography.

[4] Klebs, "Prager med. Wochens.," 1878, No. 49.

[5] "Breslauer Klin.," Bd. i, S. 260.

Congenital Cystic Elephantiasis.—In this disease there is a great overgrowth of the subcutaneous connective tissue all over the body, and at intervals in the hypertrophied tissue there are cysts varying in size. Malformations of a grave character are commonly associated with the disease. The infants scarcely ever survive their birth. One child, however, lived thirty minutes and another was twenty months old when the case was reported. Ballantyne [1] has collected more than eighteen cases of this very rare disease.

Spontaneous Fractures in Utero.—The fetal bones may be broken by external violence, or a child may be born presenting numerous fractures, especially of the long bones, either recent or already undergoing repair, without the history of an accident of any kind to the mother during pregnancy. If in such cases one can exclude a syphilitic osteochondritis, with a separation of the epiphysis and diaphysis, or an injury to the child during

Fig. 119.—Congenital cystic elephantiasis.

labor, there must have been a rachitic condition of the bones or an arrest of ossification, to allow of fracture by the slight force which could be exerted by the fetal muscles or the pressure of the uterine walls. Link [2] describes a case of numerous fractures *in utero* of the ribs, clavicle, and extremities, in which syphilis, rachitis, and chronic parenchymatous osteitis could be excluded, and he, therefore, concludes that these fractures were

[1] "Diseases of the Fetus," Edinb., 1895, 2 vols.

[2] "Archiv f. Gyn.," Bd. xxx, 2, p. 264, 1887.

caused by an "unknown intra-uterine fetal bone disease," in which the bones became soft and brittle. A similar bone disease has been described by Schmidt.

Luxations and Ankylosis.—Luxations affect females four times as often as males,[1] and are much more common in the lower than in the upper extremities. An apparent ankylosis[2] after birth occasionally appears when, in breech presentations, the presenting part has remained a long time in the cavity of the pelvis. The lower limbs remain in the position—of flexion of thighs upon abdomen and extension of legs upon the thighs—that they occupied *in utero*, and it is impossible for a while to restore them to a proper position.[3]

Intestinal Invagination.—Lauro[4] has described a double invagination of the descending colon during intra-uterine life.

Intra-uterine amputations are rare.[5] They are usually due to amniotic bands. But this explanation will not suffice for all cases. It has been demonstrated that a gangrenous process[6] at a certain point in the limb may determine an amputation, just as it would in extra-uterine life, or that a peculiar morbid process[7] may produce a constriction from the circular contraction of connective tissue at a certain point, or, again, that an amputation[8] may follow a fracture. The amputated part may float loose in the amniotic liquid, may possibly be absorbed if detached early in embryonal life, or may be attached to the sound portion of the limb by a filament.

Fetal Traumatism.—The fetus is well protected from external violence, but it may experience injuries of the gravest nature, either in connection with serious injury to the mother or occasionally with very slight evidences of violence to the maternal tissues. Thus, in cases of gunshot,[9] stab,[10] or other perforating wounds of the abdomen in pregnant women, the fetus has likewise been severely

[1] Tarnier et Budin, *loc. cit.*

[2] Lefour, "Presentation du Siège décompléte Mode des Fesses," Paris, 1882.

[3] The fixation of the limbs or trunk in abnormal positions by muscular contraction may occur *in utero* during pregnancy, as in the interesting case of "contracture" *in utero* (Ribemont-Dessaigne, abstract in "Nouv. Archiv d'Obstét.," Sept., 1887). In this connection the student should consult also the paper by Matthews Duncan on "Extensions and Retroflexions of the Fetus, especially of the Trunk, during Pregnancy" ("Trans. London Obstet. Soc.," xxvi, 1884, p. 206)

[4] "Annali di Ostet. e Ginecol.," Luglio-Agosto, 1887.

[5] For an extensive bibliography see Tarnier et Budin.

[6] Chaussier, "Procès verbal de la Distribution des Prixes à la Maternité," 1822.

[7] Kristeller, "Monatschr. f. Geburtsh.," Bd. xiv, p. 817.

[8] Martin, "Gaz. Hébdom.," 1858, p. 384.

[9] Hays, "Ann. de Gyn.," 1880, xiii, p. 153.

[10] Fennell, "Trans. N. Y. Path. Soc.," iii, 249; Tarnier et Budin, *loc. cit.*, p. 345; Guelliot, "Gaz. des Hôp.," 1886, p. 405.

and fatally wounded. Also, in the performance of celiotomy,[1] by a mistaken diagnosis the trocar that was plunged into what was thought to be an ovarian cyst has penetrated the fetus, and wounds have been inflicted by both sharp and dull instruments ignorantly used to bring on an abortion or in the hands of physicians who overlooked the condition of pregnancy. On the other hand, as instances of fatal injury to the fetus without apparent injury, externally, at least, to the mother, might be cited the cases of Mascka[2] and Gurlt,[3] in which the cranial bones of the fetus were fractured by the mother falling from a height, or the case described by G. von Hoffman,[4] of a woman in the fifth month of pregnancy who threw herself out of a fourth-story window and was killed by the fall, although she exhibited no signs of external injury; the uterus was uninjured, and the fetus externally was apparently unharmed, but on opening its abdomen the liver was found almost disintegrated. The case reported by Lumley[5] shows more clearly how slight violence to the mother may be fatal to the fetus: A pregnant woman, within ten days of term, attempting to enter a doorway, slipped and struck the left lower portion of her abdomen against the edge of the door. The movements of the child thereupon ceased, and eight days afterward a dead fetus was born with a fracture of the left frontal and parietal bones of the skull. One of my patients was thrown from a carriage two months before her delivery. Her infant, otherwise healthy, had a fractured clavicle, almost entirely healed, but with a large mass of callus about the site of fracture.

These cases of fetal injury are not only interesting from their rarity, but they are also important from a medicolegal point of view. Thus, Gorhan[6] records the death of a fetus from violence done the mother at the hands of another woman in the course of a brutal quarrel between two sisters-in-law, during which the pregnant woman, being at the time in the sixth month of gestation, was thrown to the ground and stamped upon by her infuriated relative. Two months afterward a dead fetus was born, corresponding in development to the sixth month of pregnancy, and exhibiting a transverse fracture of both parietal bones. A young girl illegitimately pregnant, under my charge in the Maternity Hospital, ran a long hat-pin up to its head into her

[1] Goodell, "Lessons in Gynecology," p. 352.
[2] "Prager Vierteljahrschrift," 1857.
[3] "Monatsch. f. Geburtsh.," 1857, p. 343.
[4] "Wien. med. Presse," xxvi, 1885, Nos. 18, 20, etc.
[5] "N. Y. Med. Rec.," 1886, p. 359.
[6] J. Taber Johnson, "Trans. Am. Gyn. Soc.," vol. iii, p. 107.

abdomen at the umbilicus. She transfixed her fetus, which was born dead a few days later. She suffered no other inconvenience than a slight purulent discharge from the umbilicus. It might be important to distinguish injuries experienced during labor, as fractures of the extremities or of the spine,[1] or depressions of the skull,[2] from the effects of traumatism during pregnancy.

Conditions of the Mother Which Injuriously Affect the Fetus.—The Influence of Maternal Fever upon the Fetus.—The well-known experiments of Runge,[3] published in 1877, were for some time accepted as conclusive proof of the great danger to the fetus of high temperature in the mother. Pregnant rabbits placed in a hot box until their body-temperature had risen to 105.8° usually died, and almost invariably the fetuses were found dead upon opening the animal's body immediately after its removal from the box. But in 1883 Doléris[4] showed that if the temperature of the animals was slowly raised to 105° or 106°, and not within an hour, as in Runge's experiments, they seemed to bear it without much inconvenience, even if long continued, and, if pregnant, their young remained perfectly healthy. These results were confirmed by Runge[5] in a second set of experiments, in which he found, however, that if the animal's temperature was raised, even very gradually, to 109.4°, there occurred the same symptoms—death of the fetus and heat-stroke of the mother—as though the temperature had been quickly raised to 106°. Preyer[6] has also shown that the fetus is capable of enduring a much higher temperature than was formerly supposed, for in one instance he actually observed a fetal temperature, in a guinea-pig, of 111.2°, taken *in ano*, the fetus living nine minutes, or until the cord was severed and it was removed from the uterus. In view, therefore, of these experiments, it seems necessary to modify the views formerly entertained, that the existence of fever in the mother must of itself necessarily threaten the life of the fetus, unless, indeed, the temperature should rise suddenly, as in the case of brain-tumor described by Runge, or in cases of recurrent fever recorded by Kaminski,[7] or else should reach an extreme height, as it might in insolation.

As to the treatment of fever in pregnant women with a view to its influence on the fetus, no special measures are required

[1] "Wien. med. Presse," xxvi, p. 370.

[2] There are, however, two recorded cases of this injury occurring from traumatism during pregnancy. [3] "Archiv f. Gyn.," Bd. xii, p. 16; Bd. xiii, p. 123.

[4] "Comptes rend. hébd. Séances de la Société de Biologie," Nos. 28, 29. Doléris' results were confirmed by experiments of Doré ("Arch. de Tocol.," 1884, p. 141), and by Negri (see abstract in "Nouv. Arch. d'Obstét. et de Gynéc.").

[5] "Archiv f. Gyn.," Bd. xxv, S. 1.

[6] "Physiologie des Embryo," Leipzig, 1884.

[7] "St. Petersburg med. Zeitung," 1868, 117.

so long as the temperature rises gradually and remains under 105°, but above this point the danger to the fetus begins (Kaminski), and active antipyretic treatment is required. Should a pregnant woman die with a temperature as high as 109°, the performance of postmortem Cesarean section would be useless, for the fetus would inevitably die first, having no means of getting rid of its extra heat by radiation. The operation would likewise be futile in a case of death after a very sudden rise of temperature (Runge).

The Influence of Maternal Emotions upon the Fetus.—Maternal emotions and impressions may possibly affect the embryo or fetus. Many cases of mental peculiarities or diseases, or of physical defects, that have been attributed to a strong impression upon the mother during pregnancy, are explained by the existence of some systemic disease, as syphilis, nephritis, diabetes, cancer, or chronic lead-poisoning in either father or mother; by an arrest of development; by mechanical disturbance of the ovum, or, in the case of intra-uterine amputations, by the formation of amniotic bands or the disposition of the cord; but there still remain well-authenticated cases of congenital defects or peculiarities,[1] which bear too startling a resemblance to the cause of the impression upon the mother during pregnancy to be dismissed as mere coincidences. One of my patients, less than six weeks pregnant, was seized by the ear and dragged about the room by her enraged husband. The child born at term had a triangular piece lacking from the lobe of the corresponding ear.

A strong emotion on the part of the mother may be immediately fatal to the fetus.[2] Profound impressions upon the mother certainly influence the psychical development of her offspring. The idiocy of Barnaby Rudge due to maternal shock and fright is a fiction founded upon fact. The horror of King James at the sight of a naked sword may well have had its origin in the murder of Rizzio before the eyes of the pregnant Queen Mary.

There is no question that certain maternal conditions may so modify the blood in its capacity of a bearer of oxygen and nutriment to the fetus as to seriously interfere with the latter's health, if not to destroy its existence. Such is undoubtedly the case in pneumonia of the mother, which can prevent a proper aëration of the maternal, and consequently of the fetal, blood, and may so bring about complete asphyxia of the fetus, or may, perhaps, result in inspiratory efforts *in utero*, the inspiration of liquor amnii, and a subsequent development of pneumonia in the

[1] See the very interesting paper by Dr. Fordyce Baker in "Gynecol. Trans.," vol. xi, 1886.

[2] "Lancet," vol. ii, 1874.

fetus itself.[1] Whatever the cause of death, pneumonia in the mother is exceedingly fatal to the fetus.

In infectious diseases the development of specific micro-organisms in the maternal blood may so alter its normal constitution as to render it unfit for the respiratory and nutritive needs of the fetus.

Icterus gravidarum endangers the life of the fetus, either by bringing on an abortion or by first destroying its life by the poisonous action of the bile-salts,[2] or, perhaps, by the induction of cholemic convulsions.[3] Thus, Späth[4] describes 8 cases, in 4 of which the fetus was born dead; and Frerichs[5] mentions 3 cases, all fatal to the fetus. Saint Vel[6] has described an epidemic of jaundice on the island of Martinique. Of 30 pregnant women affected, 20 were delivered prematurely, and of these 20 children 19 were either still-born or died shortly after birth. Bardinet[7] has also recorded the birth of 6 dead infants out of 13 pregnant women who were suffering from jaundice during an epidemic of the disease in Limoges. Frequently as the bile-salts must traverse the uteroplacental septum and enter the fetal circulation, as evidenced by the high percentage of still-born children in women affected with jaundice during pregnancy, the coloring-matter of the bile seldom stains the fetal tissues. Lomer[8] collected 56 cases in which naturally colored children were born of jaundiced mothers, and 43 more in which the color of the child was not mentioned, so that it was presumably natural; and to these might be added another case described by Parrish. There are 6 recorded cases, however, in which the fetus or the whole ovum was undoubtedly jaundiced (Lomer).

Eclampsia.—It has been estimated that about one-half the children are still-born after the eclampsia of pregnancy or labor. The cause of fetal death is the carbonic-oxid gas in the maternal blood, the stagnation of the blood-current during a convulsion, or the toxins in the blood.

The death of the mother kills the fetus, but not necessarily at once. Life may continue in the fetus for some time after it is

[1] See Inspiration Pneumonia.
[2] Valenta, "Oesterreichische Jahrb.," xviii, 1869, S. 163.
[3] Stumpf, "Archiv f. Gyn.," Bd. xxviii, H. 3.
[4] "Wiener med. Wochens.," 1854, S. 757.
[5] "Klin. der Leberkrankheit.," 1858, Bd. i.
[6] "Gaz. des Hôp.," 1862, p. 538.
[7] "Union Médicale," 1863, Nos. 133 et 134.
[8] "Zeit. f. Geburtsh.," xiii, p. 169, 1886.

extinct in the mother. Kergaredec's view that twenty-four hours might elapse between the death of the mother and the fetus is preposterous. There is on record, however, a well-authenticated case of the extraction of a living child from the womb of a woman who had been dead two hours.[1] Tarnier[2] performed a postmortem Cesarean section upon a woman who during the Commune in Paris had been killed by a stray bullet in the wards of the Maternité, and extracted a living child, certainly three-quarters of an hour—perhaps an hour and a quarter—after the death of the mother. Numerous other instances are recorded of postmortem Cesarean operations, or the extraction of infants *per vias naturales*, at intervals of time ranging from a few minutes to a half hour after the death of the mother. The remarkable survival of the fetus under conditions which would seem to make life impossible is explained, perhaps, by the cases of children born asphyxiated, whose hearts continue to beat, although they do not breathe for a long time after birth, or by the experiment performed by Haller[3] of forcing a bitch to give birth to her pups under water, where they crawled about and lived for half an hour.

The death of the fetus may be due to many causes. It may be the result of injuries, deformities, or diseases in the fetus itself, or in its appendages, the membranes, and the placenta. It may be due to inherent weakness in either the ovule or the spermatic particle, which does not prevent conception, but renders the embryo incapable of development beyond a certain point; or it may be the consequence of a misplaced ovum, as in tubal, ovarian, and abdominal pregnancies. The condition of the maternal blood, the existence of a very high temperature in the mother, and perhaps strong emotions, are occasionally responsible for the destruction of fetal life. All these conditions have been or will be considered in their appropriate places; but it remains to notice the effect of fetal death upon the

Fig. 120.—Two years in the abdomen (Baer).

[1] Hubert, "Traité d'Accouchements," vol. ii, p. 160.
[2] Tarnier et Budin, ii, p. 571.
[3] "Elém. Physiol.," vol. iii, p. 314, quoted in Tarnier et Budin, *op. cit.*, p. 570.

mother, the diagnosis of fetal death, the habitual death of the fetus, and the changes that ensue in the fetus itself after death.

The effect of the death of a fetus upon its mother is often *nil.* There may be depression, loss of appetite, and chilly sensations. When the dead body putrefies, or when, after absorption of the soft parts there is an attempt to discharge the fetal bones by ulceration into the bladder, vagina, rectum, or externally through the abdominal walls, the mother's health and safety are seriously endangered. Thus, after ectopic gestation the dead fetus may remain for an indefinite period within the

Fig. 121.—Calcification of capsule (in abdomen unknown length of time).

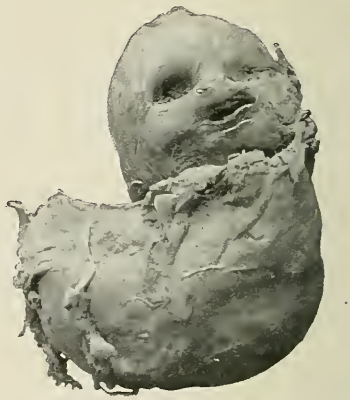


Fig. 122.—Lithopedion. Two years in abdomen (Baer).

mother's abdomen with no inconvenience except the enlargement of the abdomen; but should the germs of putrefaction gain access to the dead body, as they may by reason of the contiguity of the intestines (Litzmann), then a general suppurative peritonitis may be developed and rapidly prove fatal. So, too, in the retention of blighted ova[1] or in cases of missed labor[2] there is usually no evidence of serious harm to the mother until the putrefaction of the dead body begins, when there may be shortly manifested all the symptoms of septicemia, unless the uterine cavity is speedily cleared of its contents and well disinfected.

[1] See Gehrung, "Weekly Med. Review," Chicago, 1885, p. 131; "Westminster Hospital Reports," 1885, i, 119; "Tokio Med. Journ.," 1886, No. 439. Graefe, in Ruge's "Festschrift"; Stäger, Inaug-Diss., Bern, 1895.

[2] Lusk, "Science and Art of Midwifery," 1886, p. 304.

It is not easy to determine that the fetus is dead. If death occurs during early pregnancy, the uterus usually ceases to grow and the circumference of the abdomen no longer increases steadily from week to week; the breasts soon become flabby, although it is not rare for milk to appear for a time after the death of the fetus; the woman may complain of subjective symptoms, as a feeling of weight and discomfort in the hypogastric region (Lusk); but doubt is usually soon solved by the expulsion of the ovum. Should the fetus die in the later months of pregnancy, the movements, theretofore perhaps active, are no longer felt by the mother, and the fetal heart-sounds are no longer heard. Neither of these signs, however, is entirely reliable, for the woman's statement is not always perfectly credible, and it is impossible occasionally to hear the fetal heart-sounds, although the child is alive and well. The urine of the mother commonly undergoes a change after fetal death. Albuminuria sometimes disappears when the fetus dies. On the contrary, I have seen albuminuria appear in consequence of fetal death. Peptonuria may be looked for if there is decomposition of the fetal body, and acetonuria, it is claimed, is an invariable consequence of a dead fetus *in utero*.[1] The statement is made that the urobilinuria, present in all pregnant women, is always more exaggerated in the first few days after fetal death.[2] Negri[3] was able to make the diagnosis of fetal death during pregnancy by abdominal palpation, the fetus presenting a rather confused outline and giving rise, upon pressure on the mother's abdomen over the region of the fetal head, to an indistinct crepitus. During labor a doubt may arise as to whether the fetus is dead or alive, and upon the decision often depends the performance of embryotomy or of a more conservative operation. It has been suggested by Cohnstein[4] and Fehling[5] that if the temperature of the uterus is no higher than that of the vagina, the child may safely be pronounced dead; for the living fetus, having a higher temperature than its mother, imparts some additional heat to the maternal structures about it. Priestley[6] more practically suggests that the hand be introduced into the uterus in order to feel in the precordial region for the impulses of the fetal heart, or to feel the pulsations in the cord.

[1] Acetonuria was found 9 times in 139 pregnant women, and in each of the 9 cases it was demonstrated that the woman was carrying a dead fetus. Vicasella, "Wien. med. Presse," 1894, p. 205.

[2] Merletti, "Centralbl. f. Gyn.," No. 16, 1902.

[3] "Annali di Ostetricia," May, June, 1885, p. 223.

[4] "Archiv f. Gyn.," Bd. iv, H. 3.

[5] *Ibid.*, Bd. vii, S. 143.

[6] "Lancet," Jan. 23, 1887.

After death the fetal tissues in time saponify (adipocere), partially calcify, mummify, or else are totally or partially absorbed. Shortly after death there may be maceration and putrefaction. Before the second month the product of conception may be entirely absorbed. After that time the changes that take place depend to some extent upon the position of the fetus. Within the uterus the dead fetus is first macerated, becoming bloated in appearance, with a grayish-colored skin deprived of its epidermis in spots of varying extent; the head is enlarged, the cranial bones are loose under the scalp, and the tissues become so soft and friable that very slight force is sufficient to detach the limbs from the body. If saprophytes gain access to the fetus in this condition by rupture of the membranes, decomposition rapidly ensues. The other changes that affect the fetal tissues after death are a saponification, and possibly mummification, in which latter state they will remain for an indefinite period without change. It is in abdominal pregnancies that the dead fetus becomes converted into a so-called lithopedion, which consists not of a calcification of the whole mass, but (1) of a calcification of the membranes after absorption of the liquor amnii; (2) of a calcification of the membranes and those points on the fetus where the membranes adhere to the fetal surface; or (3) of a deposition of lime in the vernix caseosa after the membranes have been ruptured and the fetus has escaped into the abdominal cavity.[1] The fetus in the abdominal cavity may undergo all the other changes that have been described, including putrefaction, and, in addition, the soft parts may be absorbed, the bony skeleton remaining as a foreign body in the abdomen until it is discharged piecemeal, through openings into the bladder, intestines, rectum, uterus, and vagina, or externally through the abdominal walls.

The Habitual Death of the Fetus.—There are women who in two or more successive pregnancies, usually at the same period in each, give birth to dead children. It is important to learn, if possible, the cause of the repeated fetal death, for upon it depends the treatment adopted to secure the birth of a living child.

Although by no means the only cause of the habitual death of the fetus syphilis is by far the most frequent. According to Ruge's[2] estimate, eighty-three per cent. of repeated premature and still-births are due to syphilis in one or both of the parents.

[1] Küchenmeister, "Archiv f. Gyn.," Bd. xvii, p. 153.
[2] "Zeit. f. Geburtsh.," Bd. i.

But there are many cases in which syphilis can with certainty be excluded, and in which the death must be ascribed to other causes.

Certain Conditions of the Uterus which Interfere with the Development of the Fetus.—There are no reliable statistics in regard to the relative frequency of the causes, other than syphilis, of habitual death of the fetus, but I should place first chronic endometritis and chronic metritis, which interrupt pregnancy, either by effusions of blood into the hyperemic mucous membrane, and the consequent excitation of muscular action in the uterus, or by an active growth of the decidua and the diversion of the nutritive blood-supply from the fetus to the uterine mucous membrane.[1]

Abarbanell [2] first called attention to chronic metritis as a cause of habitual abortion, from the excessive development of fibrous tissue in the body of the uterus, which by loss of elasticity would interfere with a sufficient dilatation of the uterine cavity. Such, perhaps, is the explanation of Baudelocque's case,[3] in which, after a Cesarean section, a woman successively gave birth to four children at the seventh month of pregnancy. In two cases under my observation an ill-developed uterus was the cause of repeated premature births. In one the woman gave birth to thirteen children at the sixth month, none of which survived. In the other there were three premature births before the children were viable. In this woman menstruation began in the eighteenth year; there were long periods of amenorrhea, and a vaginal examination before marriage revealed an infantile uterus.

Alterations in the Maternal Blood that are Fatal to the Fetus.—Scanzoni [4] pointed out that a high grade of anemia in a pregnant woman might be fatal to the fetus. The anemia may be due to an exaggeration of the hydremia which is characteristic of pregnancy, or to the development of pernicious anemia; [5] to sudden loss of blood, or to lack of proper or sufficient food. To this last cause may be attributed the large number of abortions and still-births that occurred during the siege of Leyden (Hoffmann), or in Germany during the year 1826, when the crops failed (Nägele), and during the siege of Paris (Priestley).

Plethora might possibly prove a predisposing cause to effusion of blood into the membranes or placenta, especially at a time corresponding to a menstrual period.

[1] "Geburtshülfe," 8th ed., Bonn, 1884, p. 405.
[2] "Monatschr. f. Geburtsh.," xix, S. 106.
[3] Leopold, "Archiv f. Gyn.," Bd. viii, p. 253.
[4] "Geburtshülfe," Bd. ii, S. 3 u. 70.
[5] Gusserow, "Archiv f. Gyn.," Bd. ii, S. 218.

The Effect of Chronic Diseases of the Mother upon the Fetus.—Women affected with tuberculosis,[1] cancer, or chronic malarial poisoning [2] may give birth to a succession of dead children. Icterus gravidarum also, whether simple, epidemic, or pernicious, might be a cause of repeated fetal death, although the course of the last two is usually too rapid to allow of repeated impregnation.

Nephritis.—Fehling[3] has called attention to the influence of maternal nephritis as a cause of repeated still-births. The death of the fetus is often the result of the morbid condition of the blood-vessels in the maternal portion of the placenta, corresponding to the condition found in the lungs, brain, and other organs in chronic nephritis. The brittleness of the capillary walls leads to apoplexies and to the formation of large infarcts in the intercotyledonic spaces, which so compress the neighboring placental villi that they can not perform their physiological functions. The effusion of blood may also cause a premature detachment of the placenta.[4]

Charpentier and Butte[5] have shown that an excess of urea in the maternal blood may prove fatal to the fetus by the direct poisonous influence of this substance. Disturbances in the maternal blood-pressure (Runge) and insufficient oxygenation of the maternal blood may also occasionally be responsible for the fetal death.

Diabetes.—This disease seems to have a most disastrous influence upon the fetus. Matthews Duncan[6] collected the record of 19 pregnancies occurring in 17 women, in 7 of which the fetus died in the latter part of pregnancy. In 2 cases the children were feeble at birth, and 1 child was diabetic.

Chronic Poisoning.—Constantin Paul[7] first described the ill effects of saturnism upon pregnancy. Of 123 conceptions observed by him in women the subject of chronic lead-poisoning, 64 ended in abortion, 4 in premature labor, and there were 5 still-births; only 10 children passed the age of three years. These observations have since been confirmed by Roque[8] and Rennert.[9]

[1] Tarnier et Budin, *op. cit.*, p. 89.
[2] Bompiani, "Annal. di Ostet.," vii, 42, 46; discussion of Dr. Schrady's paper, "Med. News," 1885, i, 358; Negri, "Annal. di Ostet.," viii, p. 277.
[3] "Archiv f. Gyn.," Bd. xxvii, p. 300.
[4] Winter, "Zeit. f. Geburtsh.," Bd. xi, S. 398.
[5] "Trans. Ninth International Medical Congress."
[6] "Obstet. Trans.," London, vol. xxiv, p. 256.
[7] Tarnier et Budin, *op. cit.*, p. 31.
[8] "Thèse de Paris," 1873.
[9] "Archiv f. Gyn.," Bd. xviii, p. 109.

It has also been asserted that female workers in tobacco are peculiarly liable to abortion or to still-births (Jacquemart, Kostial), but there is difference of opinion on the subject. The late Professor Hunter Maguire, of Richmond, Virginia, kindly inquired for me of some of the largest tobacco-manufacturers in that city as to the effect of tobacco on the pregnant women in their employ. There was no evidence of a deleterious influence upon pregnant women or their offspring.

Causes of Death Residing in the Fetus Itself.—It has been already stated that syphilitic disease of the fetus or ovum is by far the most frequent cause of habitual death; but there may be other causes residing in the fetus itself which remain after the rigid exclusion of syphilis. It is well known that deformities may be hereditary in certain families, carried through every member of several generations.[1] A woman might, therefore, give birth to a number of children, each presenting the same deformity, grave enough perhaps to destroy life.[2] Leopold[3] discovered a curious affection to be the cause of death in several dead fetuses born successively of one woman. This consisted of a thickening of the fibrous and muscular coat of the umbilical vein so that its caliber was seriously diminished. Syphilis was excluded.

The Causes of Fetal Death Referable to the Father.—In case it is impossible to attribute the habitual death of the fetus to inherent defects or to ill-health of the mother, the explanation may be sought in the condition of the father. He may be too old or too young to furnish a fecundating germ of sufficient vigor to enable the fetus to reach maturity; or he may be the subject of some chronic debilitating disease, as nephritis, diabetes,[4] phthisis,[5] cancer,[6] or chronic lead-poisoning,[7] which may not affect the fecundating power of the spermatic particle, but renders it incapable of performing its part in building up a healthy embryo. Thus, Priestley tells of a healthy young woman, whose husband had albuminuria, giving birth first to a sickly infant and afterward aborting in three successive preg-

[1] "British Med. Jour.," Jan. 22, 29, 1887; "Am. Jour. Obstet.," 1886, p. 1108.

[2] A lioness in the Philadelphia Zoological Garden has given birth, on three separate occasions, to cubs that were deformed about the jaws and palate, and lived only a few moments after birth. This is said to be the rule with lionesses in captivity.

[3] "Archiv f. Gynäk.," Bd. x, p. 191.

[4] Priestley, "Lumleian Lectures on the Pathology of Intra-uterine Death," rep. from "British Med. Jour.," 1887, p. 8.

[5] D'Outrepont, "Neue Zeit. f. Geburtsh.," 1838, Bd. vi, p. 34.

[6] Jacquemier, "Dict. Encyc. des Sc. méd.," art. "Avortement," vol. vii, p. 537.

[7] Constantin Paul, *loc. cit.*

nancies, or until her husband succumbed to uremia. D'Outrepont also has related the following case: A woman married to a phthisical man became pregnant five times, in each instance giving birth to a dead child at the eighth month. Remarried to a healthy husband, she gave birth to four healthy infants in succession. Paul, in 39 pregnancies in 7 women whose husbands were afflicted with saturnism, observed 11 abortions and 1 still-born child, while of the 27 children born alive only 9 survived early infancy.

The Habit of Giving Birth to Still-born Children.—If all the causes in the mother that have been enumerated as responsible for the death of the fetus are excluded, if there is no sign of abnormality or disease in the fetus or ovum, or if there is nothing in the condition of the father to account for the repeated still-births, their occurrence may be attributed to a habit of the mother of giving birth to dead children. Such cases are extremely rare, as may be imagined, but are by no means unknown. Two examples may be cited: A woman [1] subjected to a severe fright in the last month of pregnancy afterward gave birth to a dead child. In twelve successive pregnancies she gave birth to dead children at the seventh month. The mother of Hohl [2] gave birth alternately to living and dead children. The first child was living and healthy, the second dead, and so on until the tenth pregnancy, when so certain was everyone that the child would be born dead that nothing was provided for it. It was born alive, however, and was Hohl himself.

The Diagnosis of the Cause of Repeated Still-births.—The suspicion of syphilis in the parents usually first enters the mind of a practitioner who meets with cases of habitual death of the fetus; but, aside from the possible injustice of such a suspicion, it may suggest inappropriate treatment. It is, therefore, important to discover the true cause of the inability of the woman to bear a living child, for the preventive treatment of the still-births must differ radically with each of the many causes that have been enumerated above. Syphilis, as by far the most frequent cause of habitual death of the fetus, must be first excluded before another cause is sought. But this is not always easy. It frequently happens that the history of the parents is obscure, and that the fetus is expelled already macerated or with no distinctive marks of disease upon its body. In such a case a careful examination of the fetal body and of its appendages usually reveals unmistakable evidence of the existence of syphilis.

[1] Hayes, London "Lancet," 1874, vol. ii.
[2] Tarnier et Budin, *op. cit.*, p. 365.

To determine the other causes of repeated fetal death, endometritis and metritis should be looked for. An anomalous condition of the uterus may be discovered. The blood of the mother should be examined for anemia. The lungs should be examined for phthisis, and the urine for sugar or for albumin and casts. The history of the patient may point to the existence of malaria or of chronic lead- or tobacco-poisoning. Physical signs may denote a cancer, or there may be unmistakable jaundice. The fetus itself must be examined for some hereditary defect, and the cord for stenosis of the umbilical vein. Finally, the condition of the father must be inquired into. If all other signs fail, the diagnosis must rest upon a habit or upon a hereditary predisposition of the mother.

The Preventive Treatment of Habitual Death of the Fetus.— In the case of syphilis of the parents an appropriate antisyphilitic treatment should be administered. So frequently is an antisyphilitic treatment successful in these cases that certain writers have recommended the administration of potassium iodid or mercury to every woman who was in the habit of giving birth to dead children. If a woman first comes under observation after impregnation has occurred, mercury and iodid of potassium should be administered throughout the whole of pregnancy if there is reason to suspect that the fetus may be syphilitic.

If there should be a chronic endometritis, a curettage may be followed by conception and a normal pregnancy.[1] A correction of a displacement of the uterus or a repair of a lacerated cervix may be followed by the same result. In anemic women a tonic treatment is often followed by the birth of a vigorous infant. Plethoric patients, on the other hand, would be benefited by increased exercise, by frequent depletion, and by a restricted diet. Phthisis, cancer, diabetes, or nephritis in the mother renders the prognosis for the fetus grave. In chronic malarial, lead-, or tobacco-poisoning the elimination of the poison should enable the woman to bear a living, healthy child.

The father's health, if impaired, should be improved, if possible.

There are women who carry a living child up to a certain period of pregnancy, but if allowed to go to term give birth repeatedly to dead infants. Thus, in Tarnier's[2] case, a woman, apparently in good health, gave birth to thirteen dead children successively, although it was demonstrated that the fetus was in each instance alive until the last month of pregnancy. The same

[1] Schroeder, "Geburtsh.," 8th ed., p. 405.
[2] *Loc. cit.*, p. 365.

authority cites another instance of a woman who in seven successive pregnancies experienced the active movements of her child until within fifteen days of the normal time of delivery, and yet always gave birth to a dead infant. In such cases the birth of a living child could be secured by inducing labor at a time before the period of pregnancy at which the accustomed death of the fetus occurred.

CHAPTER VI.

The Physiology of Pregnancy.

THE whole organism shows alterations in sympathy with the development of the pregnant uterus; but, as might be expected, these alterations are most striking in the genital region.

The uterus exhibits an extraordinary development in all its constituent parts. *The muscle-fibers* hypertrophy until they are eleven times as long and five times as broad as those of the non-pregnant uterus. A multiplication of the fibers, a true hyperplasia, occurs to a limited extent in the first three months. *The elastic tissue* develops with the growth of its muscle fibers. *The connective tissue* increases markedly, sending in newly developed fibers between the muscle-bundles and increasing in bulk by a serous infiltration. *The peritoneal covering* of the womb shows a true hyperplasia to enable it to keep pace with the growth of the uterus. The development of new cells is not entirely uniform, so that the peritoneum covering the womb varies in thickness. The membrane is quite firmly adherent to the uterus except over the lower uterine segment, where it is readily stripped off. *The blood-vessels* develop rapidly. The arteries are vastly increased in caliber and length and become extremely tortuous. The uterine artery sends a large branch to the upper margin of the lower uterine segment, and numerous smaller branches penetrate the uterine wall, where in some situations they communicate directly with the veins. At the placental site the arteries terminate in the curling arteries of the uterine decidua, emptying directly into the placental lacunæ, where the blood bathes the placental villi projecting into them. The uterine body may be regarded from one point of view as a huge venous plexus. The walls of the veins are reduced to the intima, and running between

muscle-bundles, the contraction of the uterine muscle after labor obliterates them.

The nerves are increased more by a development of the connective tissue about them (neurilemma) than by an increase of the nerve-elements; but there is some new development of nerve-tissue, the filaments extending toward the uterine cavity. The main supply of the womb is from the sympathetic system. The ganglia in the genital region show hypertrophy, especially the cervical.

The lymphatics are increased by hypertrophy and by hyperplasia. The lymph-spaces below the uterine mucous membrane

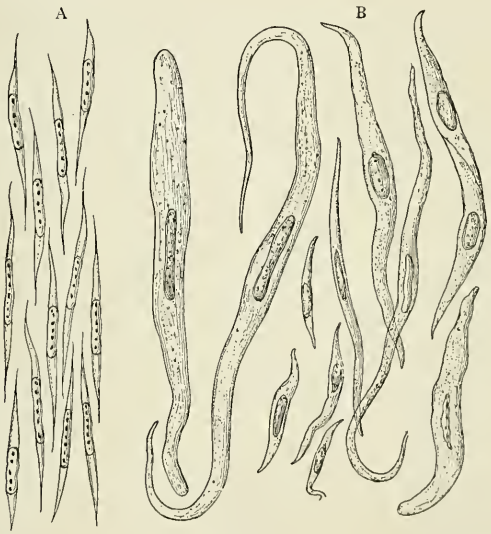


Fig. 123.—A, Isolated muscle-elements of the non-pregnant uterus; B, cells from the organ shortly after delivery (Sappey).

are enormously enlarged, and the lymph-tubes leading from them through the uterine muscles reach the size of a goose-quill. These lymph-tubes or vessels are collected in a plexus beneath the peritoneum.

This arrangement and development of the lymphatics explain in part the remarkably rapid absorption of a great portion of the uterus after labor, and account for the invasion of infectious bacteria; with peritonitis oftentimes as an early symptom, from the easy communication between the submucous and the subperitoneal lymph-spaces.

Anatomy of the Uterus at Full Term.—The muscle-fibers of the non-pregnant uterus have a very irregular arrangement. In

the pregnant womb late in gestation three layers may be distinguished: An outer, a middle, and an internal layer. The outer is continuous with the muscular fibers in the round ligaments and tubes, and is mainly longitudinal in arrangement. The middle layer is composed of bundles which pass from their peritoneal attachment obliquely downward and inward to be attached to the submucous tissue. Above the "contraction ring," or "ring of Bandl,"—the upper boundary of the lower uterine segment,—the oblique arrangement is less marked, while below it is more pronounced. The internal layer is thin and poorly developed, except around the orifices of the womb. Its arrangement is chiefly circular, and it is most strongly developed at the openings of the tubes and at the internal os.

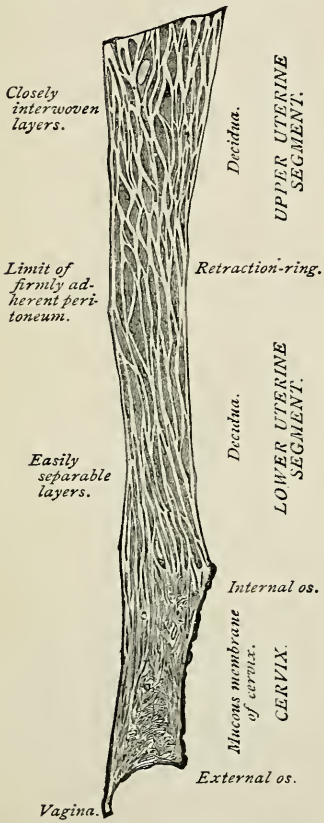


Fig. 124.—Section of the wall of the pregnant uterus. The difference in texture between cervix and lower uterine segment, according to Hofmeier, is clearly shown, as well as the loose-meshed and close-meshed muscle-layers of the upper and lower uterine segments (Hofmeier).

Changes in Volume, Capacity, and Weight.—Before impregnation the length of the uterine cavity is about 6.3 cm. (2½ in.); at term it is increased to 30.5 cm. (12 in.), while its breadth is 22.9 cm. (9 in.) and its depth 20.32 cm. (8 in.). The capacity changes from little more than 16.5 c.c. (1 cu. in.) to more than 6600 c.c. (400 cu. in.), and its weight increases from about 28.35 gm. (1 ounce) to the neighborhood of 907.2 gm. (2 pounds).

Changes in Form, Position, Direction, and Topographical Relations.—At first the uterus is changed from a flattened, pyriform body to a spherical or fig-shape, and after the fourth month to an ovoid. During the early months the uterus descends into the pelvic cavity, as a result of its increased weight. After the third month it rises steadily until the fundus reaches the epigastrium in the ninth month, but before term (four weeks in primiparæ, ten days or one week in

multiparæ) the fundus sinks again, as the presenting part and lower uterine segment become engaged in the pelvic cavity. This phenomenon is explained by contraction of the overstretched abdominal walls and a consequent diminution in the area of intra-abdominal space, the uterus and its contents being displaced in the direction of least resistance, namely, downward through the superior strait, into the pelvic cavity. During the first three months the womb exhibits a sharp anteflexion, due to the increased weight of the body and the decreased tonicity of the lower uterine segment.

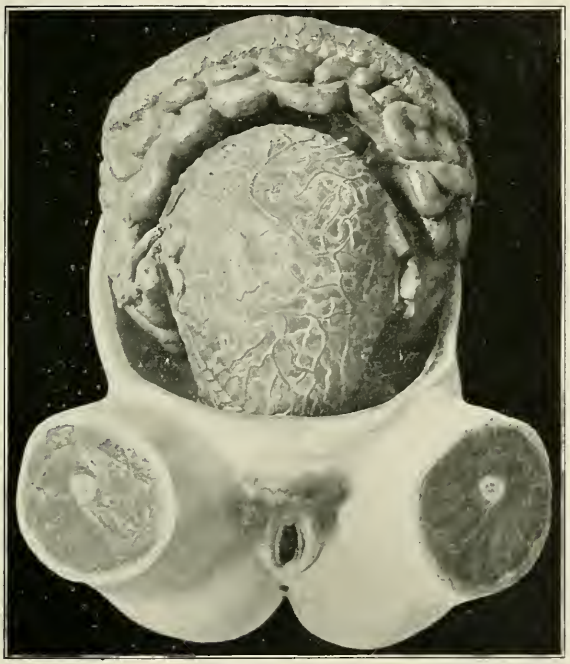


Fig. 125.—The relation of the pregnant uterus at term to the intestines.

After the third month, as the womb rises into the abdominal cavity, the laxity of the abdominal wall allows it to fall somewhat forward, so that the anteflexion persists to a certain degree, but diminishes as the womb increases in length. In consequence of the position of the sigmoid flexure and rectum, almost always distended in constipated women, the uterus is tilted to the right side and is rotated on its longitudinal axis, so that the anterior surface looks toward the right, and the left broad ligament, with its attached structures, becomes more accessible to abdominal pal-

pation. The topographical relation of the intestines is important. They should always be situated above and behind the uterus, thus giving no resonance over the anterior abdominal wall on percussion; but in rare cases of exaggerated tympany the

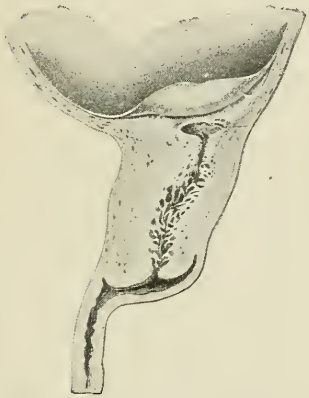


Fig. 126.—The cervix in the fifth month of pregnancy (Leopold).

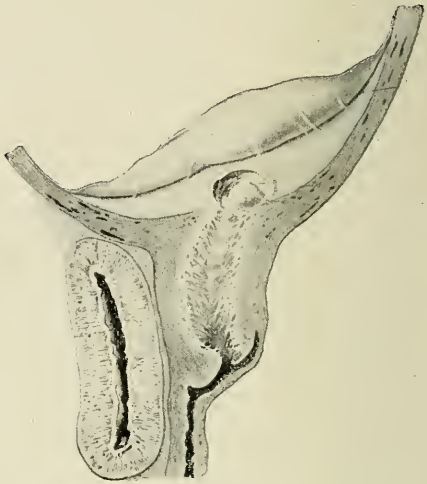


Fig. 127.—The cervix in the seventh month of pregnancy (Leopold).

intestines prolapse in front of the womb, giving a resonant note on percussion all over the abdomen.

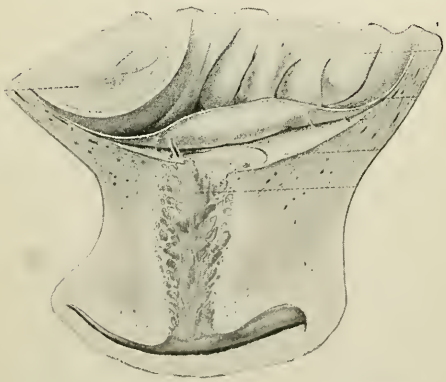
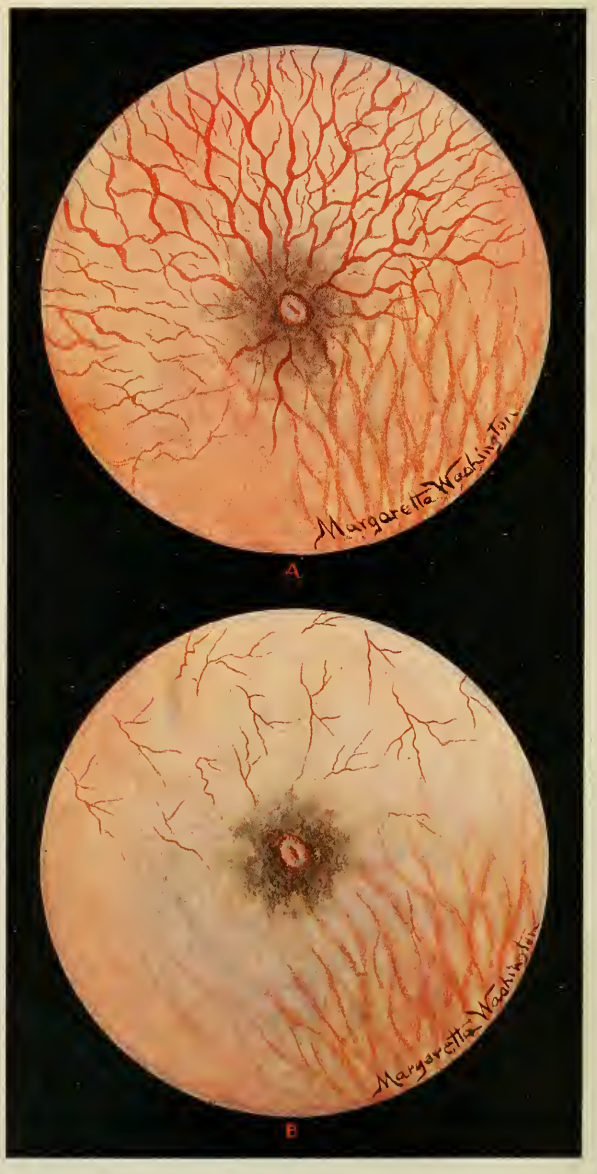


Fig. 128.—The cervix in the ninth month of pregnancy (Leopold).

Alterations in the Cervix.—The cervix is softened and somewhat hypertrophied during the first four months, but its canal is undilated until the first stage of labor begins. Throughout the whole duration of pregnancy the canal remains unaltered in length. The mucous glands of the cervix secrete a peculiarly tough mucus (mucous plug), which stops up the cervix like a cork during pregnancy.

PLATE 6.



The difference in the blood-vessel development in the bladder wall in a pregnant woman (A) and a non-pregnant woman (B), both cystoscopic views being taken around the right ureter with a water-distention instrument (F. Tilden Brown).

Alterations in Vagina and Vulva.—The changes in these regions are due mainly to an increased blood-supply, as noticed in enumerating the signs of pregnancy. Thus are explained the darkened color of the mucous membrane, the increased secretion, and the development in the muscular and mucous walls.

The pelvic joints are loosened and there is an increase in the motility of the pelvic bones, with the purpose of facilitating the passage of the fetal body in labor.

The abdominal walls show a stretching of all the constituent parts, with the formation of white, bluish, or reddish striæ, due to thinning and disorder of the arrangement of the connective-tissue layer of the skin, with atrophic changes. If this stretching of the skin is painful, partial relief is afforded by inunctions with cacao-butter, sweet-oil, lanolin, or vaselin, to increase its pliability. The recti muscles separate as the abdomen distends, and pain may be experienced in the attachments of the abdominal muscles to the ribs and to the pelvis. There is a marked deposition of fat in the abdominal walls, sometimes as early as the second month, giving the woman a much fuller figure than could be accounted for by the size of the pregnant uterus.[1]

The Bladder and Rectum.—The growth of the pregnant uterus mechanically interferes with the functions of these viscera, hence irritability of the bladder and constipation are the rule in pregnancy. By mechanical interference with the blood-supply, in addition to the congestion of the pelvis, hemorrhoids of the anus and rectum are common. Varices of the bladder, too, may develop, rarely giving rise to hematuria.

CHANGES IN THE SEVERAL SYSTEMS OF THE BODY.

GENERAL CHANGES.

Circulatory System.—The whole quantity of **the blood** is increased, but not equally in all its constituent parts. The water and fibrin-making elements are most markedly increased; the red corpuscles and hemoglobin, while actually somewhat increased, are relatively diminished; the white corpuscles are actually and relatively increased. There is therefore a physiologic leukocytosis, a hydremia, and an anemia.[2] The percentage of lymphocytes, polymorphonuclear cells, and eosinophiles appears to be unaltered.[3]

[1] The reader no doubt remembers that Roderick Random's Narcissa "had grown qualmish of late and remarkably round in the waist," when she was probably not more than six or eight weeks pregnant.

[2] For a good bibliography see Olshausen and Veit, "Geburtshülfe," 5th edition, 1902, p. 105.

[3] G. R. Pray, "American Gynecology," October, 1902.

During labor there is a distinct increase in the leukocytes, a disappearance of the eosinophiles, and an augmentation of the red blood-corpuscles. After labor the constitution of the blood returns rapidly to the normal.[1]

Recent investigations of the mutual relations of blood-serum and syncytium bid fair to solve some of the problems of fetal nutrition and maternal toxemia. It appears that the syncytial cells produce a hemolytic and the blood-serum a syncytiolytic agent. The former sets free albuminous substances in the blood designed probably for the nutrition of the fetus; the latter keeps in restraint the exuberant growth of syncytium and by the solution of the cells probably frees substances which influence both the maternal and fetal organism. If the balance between hemolysis and syncytiolysis is disturbed, it is probable that the maternal organism is adversely affected and that the toxemia of early pregnancy is a result.[2]

The left side of **the heart** is said to hypertrophy, so that its walls are increased in thickness about twenty-five per cent., and its weight increases appreciably; but Gerhardt showed that the supposed enlargement of cardiac dullness on percussion was due to displacement of the heart, and Löhlein was unable to find increased weight in a number of specimens.[3] Stengel and Stanton, in a study of 70 cases in the maternity of the University of Pennsylvania, found that there was no increase of blood pressure and no additional work for the heart to do in pregnancy; also that there was no hypertrophy of the left ventricle.[4] In consequence, it is claimed, of unusual determination of blood to the brain there are developed, in about one-half of the cases of pregnancy, on the inner table of the skull, new formations of bone, called by Rokitansky osteophytes. It has been claimed that the pulse of a pregnant woman does not undergo the usual acceleration when the patient changes from a horizontal to an erect posture (Jorisenne's sign of pregnancy). This symptom, however, is of no value. The heart of the pregnant woman shares in the nervous irritability of the whole organism, and she is liable to "cardiac nerve-storms."

The urine in pregnancy is increased in quantity, and becomes more watery, having a specific gravity of about 1014; the urea excretion as estimated by such an apparatus as Doremus's ureometer is usually below normal and is very variable. The proportion of other nitrogenous substances in the urine, ammonia and kreatinin, is increased, the percentage of urea nitrogen is decreased,

[1] Paul Corton, "Modification du Sang pendant l'accouchement et les suites de Couches normales et pathologiques"; "Ann. de Gyn.," Sept., 1903.

[2] Scholten and Veit, "Syncytiolyse u. Haemolyse," "Ztchr. f. Geb. u. Gyn.," Bd. xlix.

[3] "Müller's Handbuch," vol. i.

[4] "The Heart and Circulation in Pregnancy and the Puerperium," Stengel and Stanton, "U. of P. Med. Bull.," September, 1904.

and the total output of nitrogen is lower than normal. The other solids are about normal. It has been claimed that the urine of pregnant women in the last three months of gestation contains double and treble the usual amount of urobilin, showing the extra work thrown upon the excretory organs—both liver and kidneys.[1] Acetonuria is present in about a third of pregnant women, but has no special significance.

The digestive tract is almost constantly disturbed in pregnancy. Nausea and vomiting, beginning at about the sixth week and lasting to the third month, are so common as to be diagnostic signs of great value. These manifestations are usually worse on first arising from bed in the morning (morning sickness), and are explained either by a reflex irritation of the sympathetic nervous system due to the expansion of the uterus or by a toxemia. The assumption of the erect position suddenly increases the congestion of the uterus and aggravates its irritability. Torpor of the intestines and of the rectum, induced by pressure of the growing womb on the abdominal contents, is the cause ordinarily of obstinate constipation.

The nervous system shows remarkable changes in consequence of pregnancy. These are alterations in disposition, perversions of taste (longings), a disposition to melancholia, and possibly severe neuralgias, especially of the face and teeth.

The thyroid gland hypertrophies in about 80 per cent. of pregnant women. As it has been observed that in a large proportion of those in whom this hypertrophy fails to occur, albuminuria appears, Nicholson and others attribute to the thyroid secretion an antidotal effect upon the toxins of later pregnancy.

Changes in weight must be expected in consequence of seven pounds of baby, one pound of liquor amnii, a pound of placenta, and two pounds of uterus which are to be found in a pregnant woman at term, not to mention the increased deposition of fat all over the body and the additional quantity of blood formed in pregnancy. An increase of $\frac{1}{13}$ part of the original body-weight may be expected on the average, according to Gassner. This estimate, however, is not uniformly correct, as exceptions are frequently observed. In a series of cases which I investigated in the Maternity Hospital there was an extreme variation of from one to forty pounds in the gain of weight in pregnant women.

The changes in the respiratory apparatus are not of great importance. The lungs are shorter but broader, leaving the capacity little altered. Examination of the expired air has shown an increased activity of the lungs in the excretion of the

[1] C. Merletti, "Urobilinurie bei Schwangeren u. Vermehrung derselben in Fällen endouterinen Fruchttodes," "Centralbl. f. Gyn.," No. 16, 1902.

products of life processes, the lungs sharing the work of the other excrementory organs in disposing of the surplus effete products from mother and fetus.

Prolongation of Pregnancy and Missed Labor.—Pregnancy is quite frequently prolonged to 310 days.[1] It may have a duration of 320 days, or 40 days above the average; and there are cases on record, though somewhat apocryphal, of even longer duration.[2] In about six per cent. of pregnant women the duration of pregnancy is over 300 days. The result in labor may be most serious in consequence of overgrowth of the fetus. Some of the worst cases of obstructed labor are due to this cause. It is a good rule of practice, therefore, never to allow any woman to go more than two weeks beyond term.

Missed labor means the occurrence of a few labor-pains at term, their subsidence, and the retention of the product of conception for a varying period thereafter. "Missed labor" usually turns out to be extra-uterine pregnancy or pregnancy in one horn of a uterus bicornis; it may be due, however, to obstructed cervix from cancer, conglutination, a tumor, or excessive rigidity.

The Management of Normal Pregnancy.—Too frequently the physician gives his pregnant patients no attention, assuming that their condition is physiological and that they are in good health till they fall in labor. No view could be more erroneous. The border-line between health and disease is so easily passed in pregnancy that the most serious complications may acquire irresistible headway, undetected, unless the patient is advised carefully and constantly watched during the whole of her gestation. Constipation must be corrected. The urine should be examined once in two weeks during the whole duration of pregnancy until the last month, when the examinations should be made once a week. The routine examination for specific gravity, reaction, albumin, and sugar is sufficient in the average case. If any sign appears, indicating abnormality of kidney action, a more careful examination should be made, including total quantity, nitrogen elimination in its different forms, microscopic elements, etc.; which can best be done by an expert in urinalysis. The patient should be cautioned to reduce her physical exercise below what she is ordinarily accustomed to, and always to stop short of fatigue, avoiding particularly any sudden jolt or jar or any of the movements that strain the abdomen and increase intra-abdominal pressure, such as lifting a weight down

[1] A very extensive bibliography of prolonged pregnancy may be found in the twenty volumes of the "Jahresbericht über d. Fortschr. a. d. Gebiet. d. Gyn. u. Geburtsh."

[2] A child was presented at a meeting of the Munich Gynecological Society in 1902, born 339 days after the last menstruation. "Monatsh. f. Geb. u. Gyn.," January, 1903.

from a height (a closet-shelf) or raising from the ground a heavy weight.

The diet must be regulated so that the kidneys shall not be overtaxed. Meat should be eaten but once a day, red meat only four times a week, and a ravenous appetite, which sometimes appears in pregnancy, must not be fully gratified. Three simple meals a day with no nutritious food between meals should be the rule. Otherwise the fetus may reach an abnormal size.[1]

The patient must be cautioned against exposure to cold and wet; one such exposure or sitting in a draft after being overheated has frequently determined an acute nephritis, with fatal results to both mother and child. Tonic remedies are sometimes called for if the hydremia of pregnancy is exaggerated or if there is not a normal gain in weight. The syrup of the lactophosphate of lime is administered with advantage to stay the ravages in the teeth of pregnant women, and with this remedy internally should always be prescribed a mouth-wash of milk of magnesia to correct the acidity of secretions and to arrest the development of leptothrix buccalis, which, in the opinion of dental surgeons, are more detrimental to the teeth than the drain on the system for bone salts to build up the fetal skeleton. Strychnin in the later months is claimed to influence labor beneficially and to favor puerperal involution. This I believe to be correct. The nipples should be prepared for their future function by applications of glycerol of tannin and water, equal parts, twice a day for four weeks preceding confinement.

THE DIAGNOSIS OF PREGNANCY.

It might seem to the inexperienced that the recognition of pregnancy is easy. Every physician has ample opportunity to familiarize himself with its signs, and these signs are gross and easily appreciable, at least in the later months. But in reality there is scarcely a common condition in the human body that is so often overlooked or mistaken for something else, and there are no mistakes in diagnosis so detrimental to a physician's reputation, or sometimes so fatal to the patient, as mistakes in the diagnosis of pregnancy. To cite as illustrations only cases of which the author has personal knowledge: A physician performed what he believed would be a Cesarean section on a

[1] To reduce the size of the child in cases of moderately contracted pelves, Prochownick ("Centralbl. f. Gyn.," No. 33, 1889) proposed a diet of nitrogenous food and the least possible amount of fluids, beginning in the seventh month. Preble ("Obstetrics," May, 1899) collected 47 cases managed by this plan with apparently gratifying success.

rachitic dwarf, thought to be in labor at term. Several other physicians examined the patient before the operation, and all agreed that she was pregnant and in labor. There was nothing in her abdomen but the usual contents and a huge mass of omental fat. It was a case of pseudocyesis.

A gynecologist on the staff of a large hospital has twice operated for fibroid tumors of the womb, and only after the amputation of the uterus found that it was pregnant, and not the seat of a fibroid tumor at all. Both patients died. In a public clinic, before a large audience, a gynecologist removed what he called a myoma. The tumor was cut open immediately and all the spectators had the opportunity of seeing a pregnant uterus with a fetus in it. There was no myoma. The woman died. Another specialist in a large hospital operated for ovarian cyst. He punctured the "cyst" after opening the abdomen, and found a pregnant uterus with hydramnios. An entirely unnecessary hysterectomy was performed.

An obstetrician on the staff of another hospital attempted to induce labor on a patient in the last stages of phthisis who evidently would not live till term. The bougie, however, could not be inserted more than 2½ inches. On the following day the patient died. In anticipation of her death, all the arrangements had been made for a postmortem Cesarean section the moment she expired. The operation was performed before a large audience. The abdominal tumor proved to be an ovarian cyst, and not a pregnant uterus. A woman was admitted to the medical wards of a hospital with what was thought to be a cancer of the stomach. Gastric lavage was energetically carried out with unlooked-for success; in several weeks all gastric symptoms ceased. At the same time an abdominal tumor was observed, which, on examination, proved to be a pregnant uterus. The patient had been suffering from the vomiting of pregnancy. A young unmarried girl of good family was about to be operated upon for a splenic tumor when it was discovered that the tumor was a pregnant womb much displaced and distorted by tight lacing. A woman was sent to the author from a distant State for operation on account of a large fibroid tumor of the uterus; she was pregnant with twins, had no fibroid, and was easily delivered. A young girl was referred to the author for the removal of an ovarian cyst; her physician stated that the eminent respectability of the girl precluded the idea of pregnancy. Respectability had proved no bar to the penetration of a spermatozoön. She was pregnant at term.

The author once examined in consultation a woman who was supposed to be pregnant twelve months. Her physician and

nurse had been engaged and every other preparation made for the expected childbirth. The husband was obliged meanwhile to sell his house, but a clause was inserted in the deed that possession was not to be given the new owner till the vendor's wife should be delivered. An examination showed the womb to be unimpregnated. There had been very scanty but regular menstruation, marked enlargement of the abdomen due to omental and abdominal fat, and many of the subjective signs of pregnancy. It was a typical case of pseudocyesis. Instances of mistakes in the diagnosis of pregnancy could be multiplied to a tedious length from the author's own experience; but the cases cited should be sufficient to demonstrate the liability to error. If a physician would avoid such mistakes, he should cultivate the habit of making a routine, methodical, careful examination of every patient who may be pregnant,[1] neglecting none of the important subjective and objective signs, and looking for them in a regular order, which will preclude negligence or omission.

The signs of pregnancy, in accordance with the laws of symptomatology in general, are divided into the subjective and the objective signs; the former being the symptoms experienced by the patient herself, and the latter presenting themselves to the senses of the examining physician.

The subjective signs of pregnancy are obviously of subordinate value. The woman may wilfully deceive others or may be deceived herself. She may be unable to describe her symptoms clearly or may misinterpret them. She may be entirely unconscious of her condition, though pregnant at term. She may not even recognize the fact that she is in labor, and the birth of her infant is her first intimation that she was pregnant.[2] The subjective signs of pregnancy, arranged as far as possible in the order of their relative importance, are:

Cessation of Menstruation.—This is the most valuable of the subjective signs. It is always inquired for by the physician, and is usually first mentioned by the patient if she is acting in good faith; but it is by no means a sure indication of pregnancy, and it is not available if a woman conceives during the amenorrhea of lactation, before menstruation is established, or after the menopause. Amenorrhea may depend upon many other conditions, such as change of climate, mental and nervous disorders, periuterine inflammations, the growth of pelvic and abdominal tumors, acquired atresia of the cervix, anemia, chlorosis, and

[1] This includes all females from nine to sixty-one years of age.

[2] See "Unconscious Pregnancy," Gould and Pyle, "Curiosities of Medicine," p. 72.

phthisis. The fear of impregnation in the unmarried, the expectation of it in newly married women, the intense longing for maternity in some sterile women, and a belief in the existence of pregnancy in some cases of pseudocyesis are mental states that have been known to suspend the function. On the contrary, menstruation, or a periodical bloody discharge, persists during the first three months of pregnancy in a very small minority of cases. Rarely the flow may recur regularly, though scantily, throughout the first half or even the whole of gestation. There may, therefore, be cessation of menstruation without pregnancy, or persistence of menstruation in pregnancy. The patient's statements, moreover, are not always to be depended upon. She may deny the cessation of menstruation; she may even stain her napkins regularly with the blood of animals to deceive her family;[1] or, in cases of spurious pregnancy, she may assert that the flow has stopped, when in reality it persists, although sometimes so scantily as scarcely to attract her attention.

Nausea and Vomiting.—This symptom depends upon the distention of the gravid uterus in the beginning of pregnancy, upon a mild toxemia, and upon the irritability of the nervous system. It usually first manifests itself at the sixth or seventh week. It appears so constantly and to such a marked degree in many patients that they regard it as a certain indication of their condition, and in such cases considerable value may be attached to the patient's statement by the examining physician. I have had patients in whom nausea and vomiting appeared within the week following a fruitful coitus, though they did not suspect that they were pregnant.[2] But any irritation of the pelvic organs may produce the same result, as displacement or inflammation of the uterus, congestion or inflammation of the tubes and ovaries, and the growth of pelvic tumors. The stomach itself may be disordered and the vomiting may not be reflex. On the other hand, this symptom is entirely absent in a considerable proportion of pregnant women. Some degree of salivation is usually associated with the nausea and

[1] I was called to empty the uterus of a young girl, eighteen years of age, suffering from an incomplete abortion criminally induced. To this day her family has no suspicion of what really occurred. The girl had put her napkins in the wash at the periods when she should have menstruated, stained with beef's blood obtained from an abattoir.

[2] A Mrs. E. under my charge began vomiting within four days of the fruitful coitus in four successive pregnancies. Her uterus was retroflexed and adherent. A gentleman asked me to attend his wife in confinement, between eight and nine months later. When asked how he could suspect pregnancy so early, he replied that after breakfast that morning he had been seized with nausea and vomiting,—an infallible sign on several previous occasions that his wife had become pregnant.

vomiting of pregnancy. In rare cases the ptyalism is the predominant phenomenon.

Changes in the Size and Shape of the Abdomen.—It has been asserted that at first there is a hypogastric flattening, due to the sinking of the uterus during the first few weeks of pregnancy on account of its increased weight, but I have never found a woman who noticed this change in her shape.[1] The descent of the womb, the congestion of the pelvis, and the pull upon the uterovesical ligament, however, cause an irritability of the bladder, and of this symptom the patient often complains. Later, the abdomen is steadily and progressively enlarged until the last month, when the subsidence of the uterus diminishes the distention of the abdomen, and at the same time gives rise to symptoms of pressure on the other pelvic organs and on the blood-vessels and nerves of the pelvis and lower extremities.

There are many other causes, however, for abdominal enlargement besides pregnancy, as a deposition of fat in the omentum and abdominal walls, accumulation of fluid within the abdominal cavity, and the various abdominal and pelvic tumors. On the other hand, the enlargement of the abdomen due to advanced pregnancy may actually escape the observation of the patient herself,[2] or may be so well concealed by tight lacing as to be almost imperceptible.

Changes Due to Increased Blood-supply to the Genitalia and Breasts.—Owing to the congestion of the parts there is a tingling sensation and a feeling of fullness in the breasts, with the appearance in them of colostrum. A sense of heat and congestion may be experienced in the pelvic organs, and there is very likely to be some leukorrhea. These symptoms are obviously of little value. The striæ on the breasts, due to their sudden enlargement, may be the first sign of pregnancy to attract the woman's attention.[3]

The sudden swelling of old varices is sometimes a valuable indication of pregnancy.

Quickening.—This is the name given to the sensation experienced by the mother as the result of fetal movements, which, as a rule, become powerful enough to be appreciated by her midway between the fourth and fifth month of gestation. They may be felt as early as the third month or not until the last month of

[1] The French have a proverb: "En ventre plat
Enfant il y'a."

[2] I have seen an intelligent married woman, the mother of several children, between seven and eight months pregnant, unconscious of the abdominal enlargement and entirely ignorant of her condition.

[3] This was the case in one of my patients, a young woman of exceptionally good social position, who was illegitimately pregnant and, I believe, entirely ignorant of her condition.

pregnancy, and some women do not experience them at all or overlook their presence. They are not felt, of course, when the child is dead. The woman interested to conceal her condition will deny the occurrence of fetal movements; and other women, deceived by the action of the intestines, may honestly believe that they feel them.

Alterations in the Nervous System.—The nervous system is almost uniformly disordered in pregnancy. Characteristic nervous disturbances are described by the vast majority of pregnant women. These are changes in disposition, mental peculiarities, and perversions of tastes. There is often also a sense of dizziness, a disposition to faint, and actual syncope. For example, a woman usually amiable in disposition becomes irritable, sullen, or morose; a phlegmatic, placid individual may become unusually vivacious, and the strangest fancies for eating unusual and disgusting articles may appear. Morbid desires impelled one woman to murder her husband that she might eat his flesh, and another to revel in the sight of a butcher slaughtering animals. In some women, however, these nervous symptoms are entirely wanting or so slight as to escape observation. There are also many other causes besides pregnancy for changes in a woman's nervous organization, such as nervous strain and hysteria.

Objective Signs.—The objective symptoms are obviously of much more importance and value than the subjective. They present themselves to the physician's senses of sight, touch, and hearing.

Signs of Pregnancy Ascertained by Inspection.—*The Woman's Face.*—Splotches of irregular pigmentation, called chloasmata, appear on the brow and cheeks, and there are often dark rings under the eyes. Moreover, as a physician questions a patient in regard to her condition, he may observe evidences of truth or untruth in her countenance as she replies; though the pregnant woman determined to conceal her condition is often an actress of consummate ability.

Breasts.—The mammary glands are enlarged and obviously distended; they stand out prominently from the chest, and tortuous veins are seen plainly under the skin. As pregnancy advances, striæ may be observed in the skin of the breasts. The nipples are more prominent than in the non-pregnant condition. Around the nipples there is a deepening in the color of the pigmentation areola, and a widening of the pigmented area by the development of the so-called secondary areola of pregnancy (Fig. 129). In the pigmented area may be observed the seba-

ceous glands named after Montgomery, although he was not the first to direct attention to them and misunderstood their significance. They are often as large as buckshot in the pregnant woman, and project quite conspicuously from the surface of the skin. They are frequently, however, entirely absent. If the breast is seized at its base and compressed toward the nipple between the outspread thumb and four fingers of one hand, a drop or two of turbid fluid (colostrum) may be seen to collect upon the surface of the nipple.

All these mammary symptoms, however, may be observed independently of pregnancy, and rarely may be absent altogether in that condition. The mammary glands of some women display a marked physiological activity at each menstrual period, even to profuse milk-secretion, and it is by no means rare to observe all the mammary signs of pregnancy accompanying the growth of a pelvic or abdominal tumor, especially one of the womb itself. Moreover, the woman may be impregnated during lactation, or some activity of the glands may persist long after a

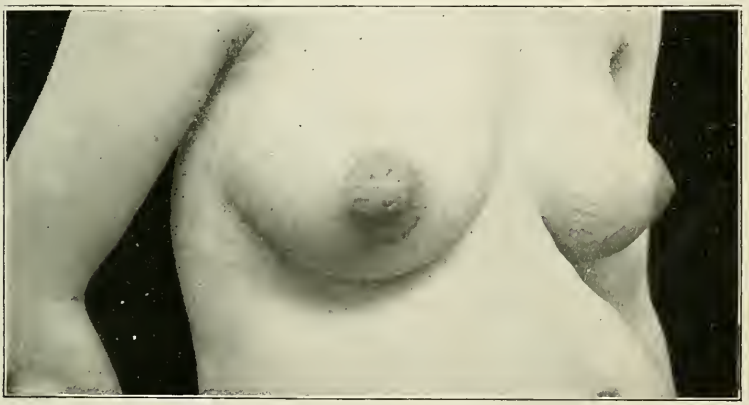


Fig. 129.—Showing the prominence of the breasts, the striæ upon them, and the pigmented areola.

previous labor. Under such circumstances the mammary signs of pregnancy are valueless.

The Abdomen.—As pregnancy advances the abdomen becomes more and more prominent; obviously containing a tumor pyriform in shape, with the narrow end downward, situated in the median line, and spreading with approximate equality to either side. There are other abdominal tumors, however, which have the same shape as a pregnant womb, and the gravid uterus is

often anomalous in form. In twin pregnancies, in breech presentations, in transverse positions, in some deformities of the fetus, in some varieties of contracted pelvis, and in the presence of

Fig. 130.—Normal pregnancy at term.

Fig. 131.—Uterus deformed by scoliosis of the spine (paralytic).

other tumors coincident with pregnancy, the pregnant uterus is altered in shape. Displacements of the uterus may also give it an unusual appearance in pregnancy.

Fig. 132.—Six months pregnant, with a large fibroid tumor. Seen in consultation with Dr. R. H. Hamill.

Fig. 133.—Breech presentation, at term.

Fig. 134.—The pendulous belly of rachitis. Pregnant at term.

Fig. 135.—Twins.

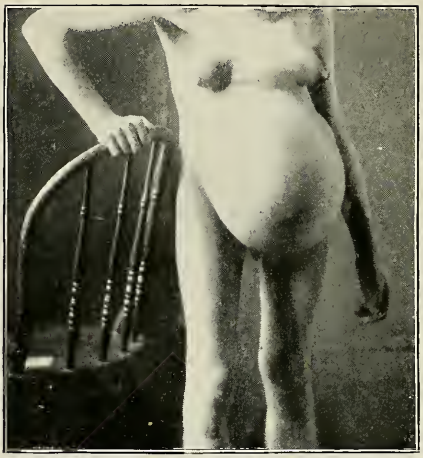


Fig. 136.—Pregnant uterus distorted by rachitic kyphoscoliosis.

Fig. 137.—Linea nigra, well marked above and below the umbilicus. Exaggeration of the pigmentation around the nipples. Half-breed Indian squaw. (University Maternity.)

The umbilicus at the sixth month is level with the surface of the abdomen, and, later, pouts. It is surrounded by a ring of pigmentation, which extends above as high as the fundus uteri, and below along the linea alba, which in pregnancy becomes the linea nigra (Figs. 137, 138). By a disorder in the arrangement of the fibers in the cutis there appear to be cracks in the skin of the abdomen, especially toward the flanks, over the surface of the iliac bones, and upon the outer aspects of the thighs. There is a disposition to hypertrichosis all over the body, but most marked on the abdomen, especially along the linea alba (Halban). If the pregnancy is far advanced, and if the fetus is alive, fetal movements may be plainly seen. These are of two kinds: there is a heaving movement of the fetal back, and a sharp, sudden tap of the fetal extremities. Fetal movements, if unmistakable, are positive signs of pregnancy, but they have been simulated by twitching of the abdominal muscles and by the vermiform movements of the intestines.

Vagina and Vulva.—The mucous membrane of the vestibule and of the vagina assumes a purple hue in the later months of gestation, which has been aptly compared in color to the lees of wine. The discoloration of the mucous membrane of the vagina and of the vaginal introitus is usually most marked upon the inner surface of the labia majora and upon the fold of vaginal mucous membrane on the anterior wall that comes into view when the labia are separated (Plate 8, Figs. 3 and 4). It is occasionally confined to the fossa navicularis (Plate 8, Fig. 2), or to the deeper portions of the vaginal rugæ. The pigmentation of the mucous membrane begins in some cases as early as the fourth week. Chadwick [1] in 281 cases found it diagnostic in thirteen per cent. at the end of the second month; in forty-six per cent. at the end of the third month. Johnson [2] calls attention to a regularly recurring change of color in the cervix from violet to pink as an early and reliable sign of pregnancy. It is due to the intermittent contractions of the uterus. The violet color of the vaginal and vulvar mucous membrane is by no

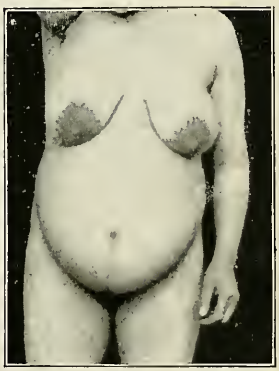


Fig. 138.—Linea nigra, visible only below the umbilicus.

[1] "Tr. Am. Gyn. Soc.," vol. ii, 1886, p. 399. See also Farlow, "The Boston Med. and Surg. Jour.," vol. cxvii, No. 3, 1887.

[2] "Journ. Am. Med. Assoc.," Feb. 20, 1904.

means an infallible sign of pregnancy. It is often absent altogether in early pregnancy, and I have frequently noted its entire absence at term. There are, moreover, other conditions than pregnancy which can give rise to it: erethism, pelvic tumors, intense congestion of the pelvis. But even if the blue discoloration is not visible, one may always notice in the later months a transformation of the pink color of the mucous membrane of the introitus into a bright scarlet.

Fig. 139.—Hegar's sign of pregnancy elicited by a combined vaginal and abdominal examination.

Signs Appreciated by the Sense of Touch.—*Abdominal Palpation.*—By this method are learned the size and shape of the uterus, and after the sixth month the fetal back, head, and extremities may be felt.[1] By placing the outstretched hand over the fundus, the intermittent uterine contractions, to which attention was first called by Braxton-Hicks, are perceived. At intervals of about ten minutes throughout gestation the whole uterine muscle contracts as it does in a labor-pain, the uterus hardening

[1] For a more extended description of abdominal palpation see "Mechanism of Labor."

PLATE 7.

Figure 1.—Breast of a non-pregnant woman of the blonde type.

Figures 2 and 4.—Breasts of pregnant women of the brunet type.

Figure 3.—Breast of a pregnant woman, a blonde.

Painted from life, showing the irregular distribution of Montgomery's glands and comparative distention of the veins in the pregnant and the non-pregnant woman when the breasts are allowed to hang unsupported by the clothing for a few minutes.

Figure 1.—Normal color of the vaginal mucous membrane in a woman not pregnant (blonde).

Figure 2.—Color of vaginal mucous membrane and introitus in a brunet.

Figure 3.—Color of vaginal mucous membrane and introitus in a negress.

Figure 4.—Color of the vaginal mucous membrane in a light blonde.

Note the scarlet color of the mucous membrane of the introitus, in addition to the blue discoloration. The former is always present, even if the latter is absent. The complexion of the individual does not necessarily influence the depth of the blue discoloration. In figure 2, a dark brunet, it is lighter than in figure 4, a light blonde.

under the hand so that its contents can no longer be easily appreciated. This sign is available at the end of the third month, and although it may be produced by any tumor distending the uterine walls, as a collection of blood, an intra-uterine polyp, or a soft myoma, it is almost a positive sign. It may, however, occur sympathetically in extra-uterine pregnancy, and it is said that the contractions of an overdistended bladder may be mistaken for the rhythmical contractions of the gravid womb. Finally, fetal movements may be felt as pregnancy advances. The sensation conveyed to the hand is usually that of a finger-tap under a blanket. The other fetal movement, however,—a heaving action of the back,—is equally characteristic. This symptom is naturally a positive sign of gestation. Fetal movements may be excited by placing a cold hand suddenly upon the woman's abdomen, or by pushing the fetus about in the womb.

Combined Examination.—The cervix in pregnancy is notably softened as a result of the increased blood-supply and an edema of the part. Goodell is the author of the ready rule of practice, that when the cervix is as hard as one's nose pregnancy does not exist, but when it is as soft as one's lips pregnancy is likely.

Rapidly growing myomata, however, acute metritis, and hematometra can produce as soft a cervix as is felt in pregnancy, and should the neck of the pregnant womb be the seat of an old injury, with dense and extensive cicatrices, or should the cervix be cancerous or syphilitic, there may be no appreciable softening in pregnancy.

Johnson[1] declares that a change in consistency of the cervix may be noted at regular intervals very early in gestation, being the first appearance of the intermittent contractions that are felt later by abdominal palpation. To detect this sign the finger must be kept in the vagina for ten minutes at a time perhaps, which is, to say the least, inconvenient.

Hegar's sign of early pregnancy depends upon a marked softening of the lower uterine segment, by which it appears on combined examination that the body and the cervix are disconnected, though on closer examination, the outer edges of the lower uterine segment appearing a little firmer than the intermediate portions, it seems that the cervix is joined to the body of the womb by two indistinctly appreciable longitudinal bands. The best method to elicit this symptom is to insert the forefinger far into the rectum and the thumb into the vagina, while the womb is pressed down by the other hand applied upon the abdominal wall.

[1] *Loc. cit.*

It is not always necessary, however, to make a rectal examination. By combined pressure, either through the anterior or posterior vaginal walls and the abdominal wall above, the finger-tips can be brought into relationship with the lower uterine segment. Hegar's sign is by no means a certain one. It is not invariably appreciable in pregnancy, and it might be felt in a non-pregnant uterus, softened by congestion, inflammation, or the presence in it of fluid.

The uterus may be asymmetrically enlarged, one side being greater than the other, and a longitudinal line or furrow separating the two (Braun-Fernwald's sign).

Enlargement of the uterus, with a change in its shape and consistency, is one of the most important symptoms in the early weeks. The womb becomes more spherical in outline, softer in consistency, and distinctly enlarged, while there is usually a marked anteflexion in consequence of the weight of the body of the uterus and of the softened lower uterine segment. By placing one hand over the fundus and the fingers of the other in the vagina an impulse may be conveyed by the latter to the uterine contents, which are displaced upward, communicating an impact

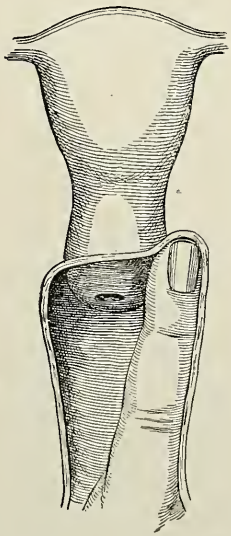


Fig. 140.—The shape and size of the non-pregnant uterus.

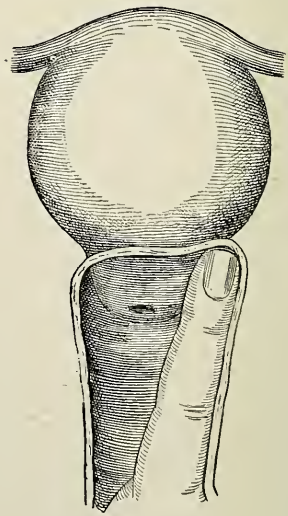


Fig. 141.—The shape and size of the uterus altered by early pregnancy (Budin).

to the external hand and falling again into its original situation; a tap is felt upon the uterine and vaginal walls by the fingers

applied internally. To this symptom the name "ballottement" has been given, and to the experienced examiner it is a positive sign of the condition, though a small cystic tumor of the ovary with a long pedicle may simulate it closely, and the same symptom might, of course, be elicited in an advanced extra-uterine gestation.

Symptoms Ascertained by Auscultation. — Mayor, a surgeon of Geneva, was the first to discover, in 1818, that the fetal heart-sounds could be heard by applying the ear to the abdomen of a pregnant woman when the child is alive. Three years later this valuable symptom of pregnancy was described in an article by Kergaradec presented to the French Academy. It is a symptom available as early as the fifth month, although its value increases with the advance of pregnancy. The fetal heart beats at the rate of about 120 to 160 a minute, and the sound has aptly been compared to the ticking of a watch under a pillow. The beat is a double one, as in the adult heart. The area of the maximum intensity of the fetal heart-sounds in anterior positions of the vertex is about an inch below the umbilicus to the left or the right of the median line, or in posterior positions of the vertex in the flanks on a line passing through or somewhat below the umbilicus. In breech presentations the maximum intensity is usually above the umbilicus, and in transverse positions the pulsations may be heard low upon the abdominal wall near the symphysis. Occasionally they can best be heard over the fundus uteri, the sound being transmitted by the fetal spine. Their absence by no means excludes the existence of pregnancy. They are not heard if the child is dead, if there is an abnormal quantity of liquor amnii in the uterus, if the abdominal walls are excessively thick, or in certain positions of the fetus. On the other hand, the beat of the maternal aorta has often been mistaken for the fetal heart, though this error is easily avoidable if one feels the maternal pulse as he listens for the fetal heart-sounds, and remembers that the aortic impulse is a single, the fetal heart-beat a double, sound.

Another sign of pregnancy appealing to one's sense of hearing is dullness on percussion along the median line of the abdomen and for some distance on either side. It is possible, however, in very rare cases of excessive tympanitic distention of the intestines, to obtain a tympanitic note all over the anterior wall of the abdomen, though the woman may be pregnant at term. In such cases the distended intestines have surrounded the womb and cover its anterior surface.

The uterine bruit, synchronous with the maternal heart-beat,

is often heard in pregnancy, but it may be heard also in large uterine myomata and in ovarian cysts. It can usually best be distinguished on the left lateral aspect of the pregnant womb, as it is caused by some obstruction to the blood flowing through the uterine artery. The funic souffle, present in about fifteen per cent. of cases, if heard, is diagnostic of pregnancy. It is a high-pitched, whistling, or hissing murmur, synchronous with the fetal heart-beat. It is caused by some obstruction to the flow of blood through the umbilical arteries.

The fetal movements may be heard, in auscultation of the abdomen,[1] as a dull thud against the abdominal walls. Feeble movements may be heard as early as the fourth month. It was while listening for the fetal movements that Mayor first heard the fetal heart-sounds.

In auscultating the abdomen of a woman for the signs of pregnancy, the examining physician should first use his ear directly applied to the abdomen with nothing but a thin towel intervening. A stethoscope should also be employed, however, in doubtful cases and in situations where the ear can not be conveniently applied.

A positive diagnosis of pregnancy before the sixth week is impossible, and the diagnosis may be only presumptive until the fetal heart-sounds can be heard and fetal movements are felt.

Clinically, the signs of pregnancy may be divided into those of three trimesters, or periods of three months each. It is useless for the practitioner to look for certain signs in one trimester only available in the next. *First trimester.*—In this period the following signs of pregnancy are available: Enlargement, change in shape and bogginess of the uterine body, soft cervix, enlargement and functional activity of the breasts, Hegar's sign, cessation of menstruation, nausea, and vomiting. The *second trimester* exhibits, in addition to the above, enlargement of the abdomen, intermittent contractions of the uterus, feeble fetal movements, ballottement, fetal heart-sounds, and blue discoloration of the vaginal mucous membrane. In the *third trimester* all the symptoms just enumerated become more easily appreciable. The outlines of the fetal body are distinguishable by abdominal palpation, and the presenting part may be felt through the roof of the vaginal vault.

Differential Diagnosis of Pregnancy from Other Pelvic and Abdominal Tumors.—Early pregnancy must be distinguished

[1] First reported by Kergaradec in 1822.

occasionally from small fibromyomata, hematometra, hydrometra, and pyometra, small cystic and solid tumors of the broad ligaments and appendages, inflammatory swellings of the broad ligaments and ovaries including exudates. In all tumors not involving the uterus itself the latter may be mapped out by careful bimanual examination, which also determines its size, consistency, and shape, and thus decides whether it is pregnant or not. In the case of pelvic and peritoneal exudate it may be impossible to feel anything through the vaginal vault except the inflammatory mass from which the cervix projects like a nipple. It may therefore be impossible to tell whether there is a coincident pregnancy and pelvic inflammation except by an exploratory abdominal section, which would not, however, be justified simply to clear up the diagnosis. Time would decide the question. If the tumor is situated in the uterus itself, the differential diagnosis may not be easy, but is almost always possible. Fibromyomata are usually stony hard, irregular in shape, and cause, as a rule, menorrhagia. Accumulations of fluid in the uterus may for a time be very puzzling, but there is usually the history of cramp-like pains at the menstrual periods, the amenorrhea has often been of longer duration than would be the case in early pregnancy, there may have been an impossibility of impregnation, and the congenital or acquired atresia of the cervix is almost always demonstrable.

The differentiation between later pregnancy and the other abdominal tumors is made by the patient's history, by inspection, abdominal palpation, auscultation, and a combined examination. It should be remembered that the pregnant uterus is by far the commonest abdominal tumor. It is numbered by the thousands in all large communities, while other growths are rare. All women, therefore, between the ages of nine and sixty-one, with an abdominal tumor, should be regarded as pregnant until they are proved to be otherwise, though the physician will do well to keep his suspicion to himself and to keep an open mind, so that he may not suffer in reputation from an egregious mistake or be responsible for a tragedy like that of Lady Flora Hastings.

Many abdominal tumors may be distinguished from pregnancy at a glance; thus, obesity (Fig. 142); an abdominal hernia (Fig. 143); a tumor in the upper abdomen (Fig. 144); an enormous abdominal distention from a large ovarian cyst, ascites, or a huge myoma (Figs. 145–147) look so unlike the abdominal distention of pregnancy that no suspicion of gestation enters the observers's mind, but it should be remembered that there may be a coincident pregnancy with any of the abdominal tumors and

that the pregnant uterus may assume a distorted form, occupy an unusual position, and reach an enormous size in consequence of multiple pregnancy, fetal monstrosity, deformities of the spine, tight lacing, or hydramnios.[1]

There are many abdominal tumors (Figs. 148, 149) that resemble closely or exactly the pregnant uterus on inspection; thus,

Fig. 142.—Obesity.

a fibromyoma, an ovarian cyst, tympanites, or a distended bladder may furnish a degree and kind of abdominal distention quite like that of pregnancy, and in the two former instances there may have been an amenorrhea corresponding in duration with that of pregnancy. In two cases under the author's notice, one of a fibroid tumor, the other of an ovarian cyst, the patients' statement to the examining physicians that they had missed their

[1] Figures 142 to 149 are from the author's gynecologic service in the Howard Hospital, Philadelphia.

Fig. 143.—Hernia.

Fig. 144.—Sarcoma of the liver.

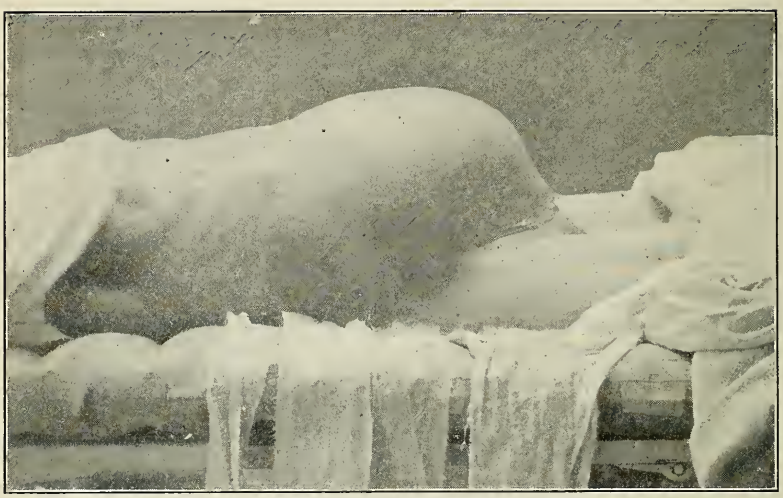


Fig. 145.—Ovarian cyst.

Fig. 146.—Carcinoma of uterus and ascites.

Fig. 147.—Tuberculous peritonitis and ascites.

Fig. 148.—Distended bladder.

sickness for nine months gave rise to such a strong preconceived idea of pregnancy that a false diagnosis was made. The correct diagnosis can almost certainly be made by a systematic search for all the subjective and objective signs of pregnancy in regular order, and in their absence by discovering the characteristic symptoms of the abdominal growth that may be present. In the case of tympanitic distention of the abdomen, deep abdominal palpation—if necessary, under anesthesia—and percussion show the absence of a solid abdominal tumor.

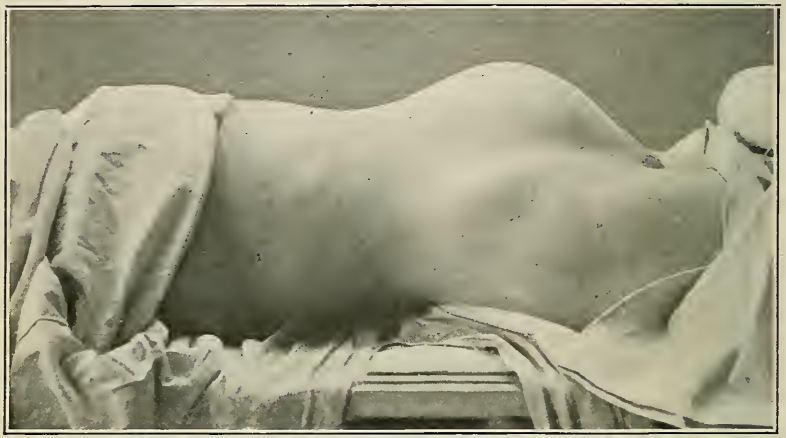


Fig. 149.—Fibroid tumor.

Estimation of the Duration of Pregnancy.—If the date of the fruitful coitus can be ascertained, labor may be expected, on the average, two-hundred and seventy-one days later.[1] Ordinarily, the history of cessation of menstruation is depended upon in making an estimate of the probable date of labor. Nägele [2] is the author of the convenient rule for predicting the date of the expected confinement by counting back three months from the first day of the last menstruation and adding seven days. For seven months of the year this method is absolutely correct. In April and September six days, in December and January five days, and in February four days should be added to obtain the date of a period two hundred and eighty days after the first day of the last menstruation. It is to be noted that the prediction of the date of labor can never be more than approxi-

1 Ahlfeld, "Monat. f. Geburtsh.," Bd. xxxiv, p. 208, based on 425 cases.
2 "Lehrbuch der Geburtshülfe."

mately accurate, as labor occurs only exceptionally two hundred and eighty days from the first day of the last menstrual period.[1] A variation of a few days either way is the rule, and prolongation of pregnancy, even to a month or more, is by no means exceedingly rare. Löwenhardt has proposed multiplying by ten the number of days between the last normal menstruation and the one preceding, thus predicting, with a greater accuracy than is otherwise possible, the probable duration of pregnancy. Thus, if the interval is twenty-six instead of twenty-eight days, the pregnancy will last two hundred and sixty days. Lusk says he has seen occasionally a curious confirmation of Löwenhardt's view, but my own experience would not lead me to prefer this method to Nägele's. If the patient is not menstruating when she conceives, as in lactation, if the history of menstruation is not attainable, or is not to be depended upon, an approximate idea of the date of pregnancy may be gained by noting the height of the fundus. At the fourth month it rises above the pelvic brim; at the fifth it is midway between the umbilicus and the symphysis; at the sixth month on a level with the umbilicus; at the seventh month about four fingers' breadth above the navel; at the eighth month about midway between the umbilicus and the xiphoid cartilage; at the ninth month the fundus reaches its highest level near the xiphoid cartilage; during the ninth month the fundus descends again almost to the level at which it was at the eighth month, the presenting part having entered the superior strait. The date of quickening is of some value in estimating the duration of pregnancy. It may be expected in the twentieth week in primigravidæ, in the twenty-first and twenty-second weeks in multigravidæ. But this symptom is exceptionally observed as early as the fifteenth, thirteenth, or even the tenth week, and some women do not notice it till the seventh month.

Diagnosis of the Life or Death of the Fetus.—The fetal heart-sounds are a most valuable sign of fetal life when they can be heard. Positive knowledge on the part of the patient of fetal movements is also of great value, and if the movements can be felt, seen, or heard by the physician, there is, of course, positive evidence of fetal life. All the signs of pregnancy without fetal heart-sounds or fetal movements usually mean a dead fetus. The most valuable sign of fetal death in pregnancy is the cessation of growth in the abdomen, which is determined by successive

[1] Ahlfeld's statistics, based on 653 labors, show that pregnancy was ended in the thirty-eighth week in 15.93 per cent., in the thirty-ninth in 27.56 per cent., in the fortieth in 26.19 per cent., and in the forty-first in 10 per cent. of the cases.

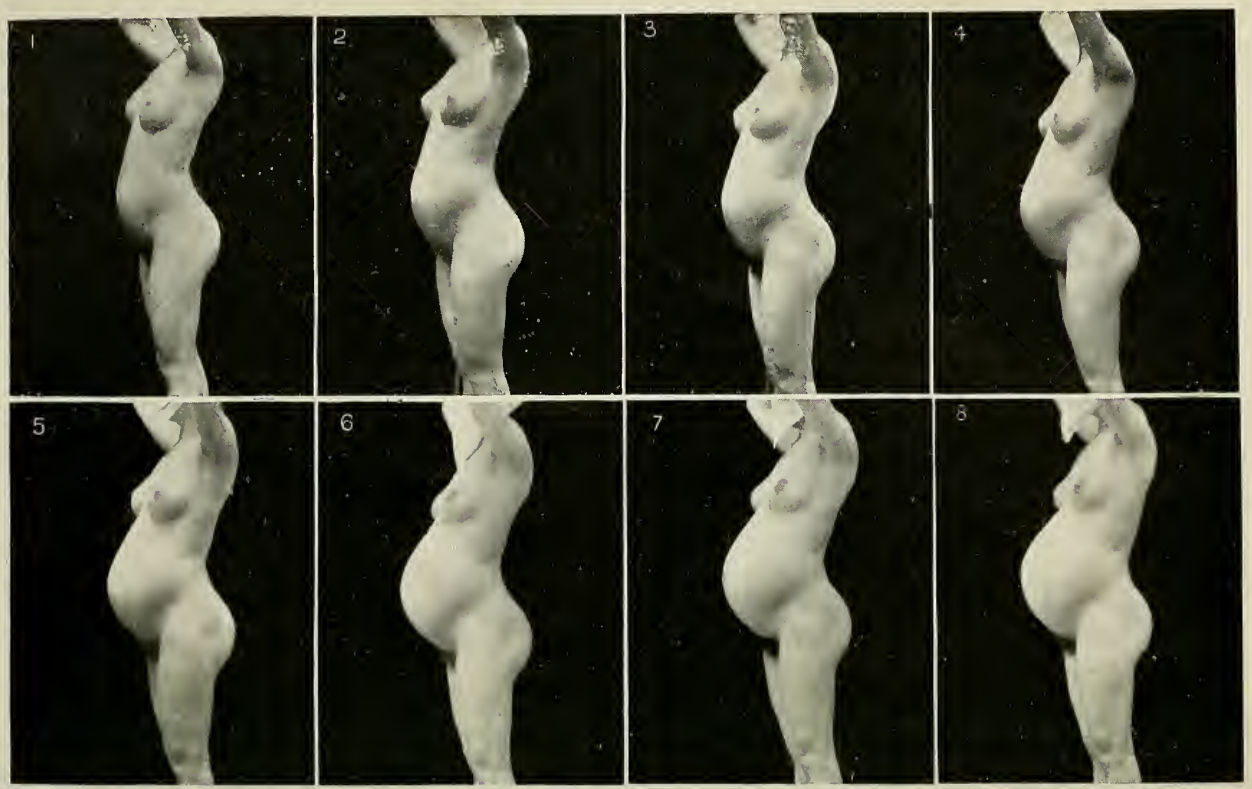


Fig. 150.—1. Photograph of a pregnant woman taken three calendar months from the first day of last menstruation; 2, 3, 4, 5, 6, 7, 8, same individual at fourth, fifth, sixth, seventh, eighth, ninth, and tenth lunar months.

weekly measurements of the abdomen with a tape-measure, care being exercised to ascertain on each occasion the maximum girth. If the fetus is alive, there is a steady increase from week to week. If it is dead, there is no increase in the abdominal measurements, and there may be a decrease. For a more extended account of the diagnosis of fetal life and death the student is referred to the section on the diseases and death of the fetus.

It is obvious that a diagnosis of life or death of the fetus is often of great importance, as a physician would be inclined to induce labor to evacuate the womb of a dead fetal body if he could be certain that the child had died; and a knowledge of fetal life or death would influence the treatment of nephritis or of other complicating diseases of gestation. In case of doubt it should be assumed that the fetus is still alive.

Diagnosis of the Sex of the Fetus.—It was thought for some time that the diagnosis of fetal sex could be made by listening to the rate of the fetal heart-beat,—a rate of 120 to 140 in the minute indicating the probability of a male fetus, while a quicker heart-beat is indicative of a female child; but observations conducted by Budin, also those in the Boston Lying-in Hospital, and others made by the author, show that there is such a variability in the fetal heart-rate from time to time that it is impossible to predict by this means the sex of the fetus.

Diagnosis of a Prior Pregnancy.—The determination of this point may be of medicolegal importance. A vaginal examination detects some degree of laceration of the cervix, usually bilateral. The cervix is large and cylindrical. The cervical canal is patulous, usually admitting the first joint of the index finger. There are old scars upon the skin of the abdomen, pointing to a former distention of the abdominal cavity, the recti muscles are separated by at least three finger-breadths, and the abdominal walls are more flaccid than in a primigravida or a nulliparous woman. The pelvic floor may be relaxed, and there may possibly be tears of the levator ani muscles. The hymen is not only torn, but is in great part destroyed, the remnants forming the carunculæ myrtiformes. The vaginal mucous membrane is smooth, and the vulva gapes so that by separation of the labia majora often a great part of the vaginal canal can be brought into view. There is often some degree of cystocele, the anterior vaginal wall bulging downward and forward into the vulvar orifice.

The breasts are ill supported and sag down, while upon the skin, especially at the base of the glands, may be seen the white and glistening scars of old striæ.

Parturition in very rare cases, especially if the child is premature and small, may leave hardly a trace behind it, and the delivery of a submucous fibroid may produce the same lacerations of the cervix and pelvic floor that occur in childbirth.

Pseudocyesis, or Spurious Pregnancy.—In women who ardently desire offspring, in those who fear impregnation, and in individuals who, without longing for or dread of maternity, believe themselves pregnant, the subjective and some of the objective signs of pregnancy may appear to so striking a degree that the patient herself is completely deceived, and not infrequently her physician shares her belief in the existence of pregnancy. I was once consulted by a prostitute who firmly believed she had been pregnant for a year, or ever since her occupation had exposed her to the danger of impregnation. The abdomen was distended; the breasts were enlarged and painful, though not secreting; menstruation was very scanty and irregular, and the woman asserted that she felt fetal movements. The abdominal distention was due to fat and gas. The uterus was unimpregnated. I have frequently seen women who put on an excessive amount of abdominal and omental fat as they approach middle age, and who, in consequence of the abdominal enlargement, believe themselves pregnant. Menstruation may be entirely absent or so scanty as scarcely to attract the woman's attention, and all the subjective signs of pregnancy may be accurately described. It often requires in these cases an examination under anesthesia before the unimpregnated condition of the uterus can be detected. Weir Mitchell asserts that once

Fig. 151.—Pseudocyesis: Amenorrhea for eight months, but vicarious menstruation from nose every month. The uterus is normal in size, position and mobility. The abdominal distention is due solely to tympanites and fat.

these women's minds are disabused of the idea that they are pregnant, the abdominal enlargement rapidly subsides, and all the subjective symptoms of pregnancy immediately disappear. Occasionally it is imposible to convince a woman that she is not pregnant if she has allowed the idea of pregnancy to take entire possession of her mind. A little, wizened old lady with gray hair, apparently sixty years old, applied for admission at the Maternity Hospital of Philadelphia. She volunteered the statement that many years before she had subjected herself to the dangers of illegitimate impregnation, and that ever since she had been pregnant. Nothing could convince her of the truth, and she indignantly left the hospital firmly possessed of her monomaniacal idea. The case shown in figure 151 is interesting. The woman had had an attack of pelvic peritonitis just nine months before. Her menstruation had been absent ever since, but there had been a vicarious flow regularly from her nose. The abdomen steadily and rapidly enlarged and the woman was firmly convinced that she was pregnant. With this idea she obtained admission to the maternity wards of the Philadelphia Hospital, having been previously examined by a physician who pronounced her pregnant at term. The abdominal distention was due entirely to tympanites, the result of partial obstruction of the sigmoid flexure, which was involved in the adhesions of the uterine appendages on the left side.

CHAPTER VII.

The Pathology of the Pregnant Woman.

DISEASES OF THE GENITALIA.

Displacements of the Pregnant Uterus.—The uterus in pregnancy may be displaced forward, backward, to either side, or downward. It may form part of the sac contents in inguinal and ventral herniæ, and it may be twisted upon its pedicle, the cervix.

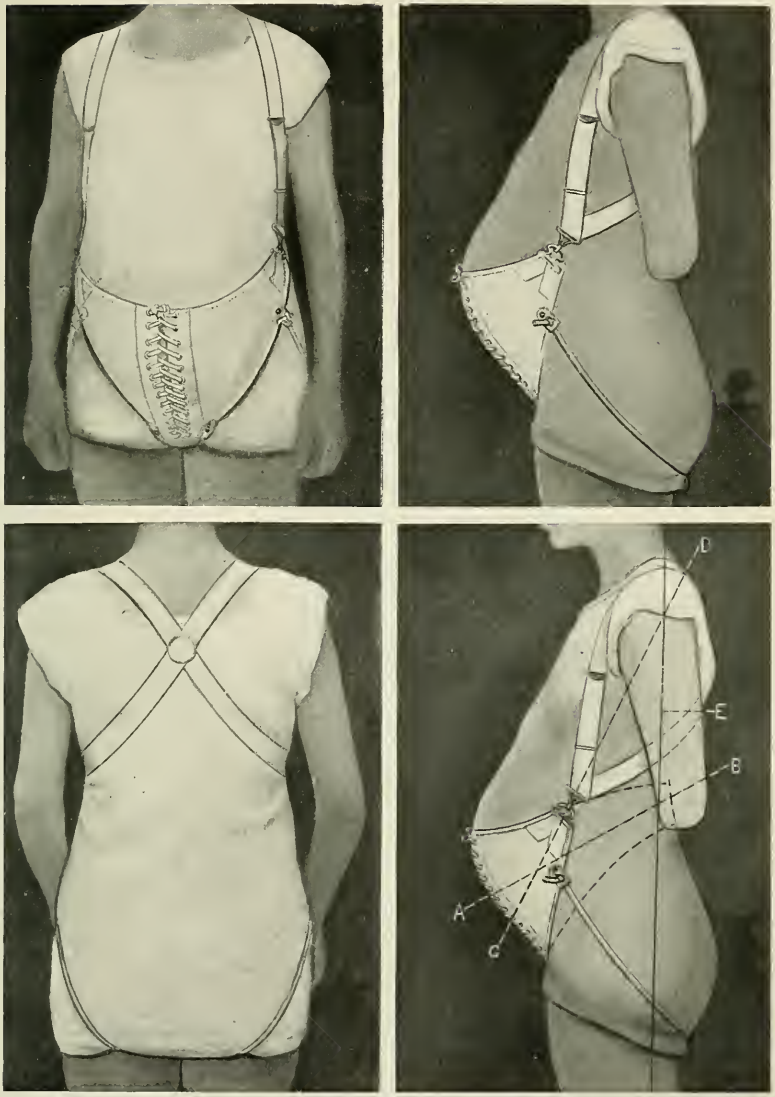
Anteflexion of the Gravid Uterus.—Usually the growth of the uterus upward into the abdominal cavity corrects the anteflexion spontaneously, but if it is bound down by bands of adhesion the result of pelvic inflammation, or the consequence of anterior fixation of the uterus by an abdominal or vaginal operation, pain in the uterus and difficulty in urination result, until finally the uterus expels its contents or forces its way up into the abdominal cavity. A number of cases have been observed of late years in which, after an anterior fixation of the uterus, the uterine

cavity enlarged solely by the distention of the posterior uterine wall, the fundus and anterior wall much thickened, remaining at the level of the pelvic brim.

Treatment.—Pelvic massage, tampons, and digital pressure upward through the anterior vaginal vault may stretch or break the adhesions and allow the uterus to ascend normally into the abdominal cavity. An abdominal section and the severance of adhesions may be justifiable. Late in gestation the whole body of the uterus may fall forward, producing a pendulous abdomen, in consequence of greatly relaxed abdominal walls; diminution in the length of the abdominal cavity, as in kyphosis; prevention of the entrance into the pelvis of the presenting part, as in a rachitic pelvis; or by reason of an exaggerated separation of the recti muscles. This anterior displacement is treated by an abdominal binder, not tight enough to increase the intra-abdominal pressure injuriously, but firm enough to afford support (Figs. 152–155).

Retroflexion or Retroversion. — Retrodisplacement is of frequent occurrence. It is explained almost invariably by the previous existence of a backward displacement, although an acute retrodisplacement of the uterus may occur in the first few months of pregnancy from the same causes that determine such an accident at other times. A persistent retrodisplacement of the gravid uterus is more common in contracted than in normal pelves, especially if the promontory is prominent. The displacement is more frequently a retroflexion than a retroversion.

Symptoms.—The earliest and most distinctive symptoms are a gradually increasing *dysuria*, and distention of the bladder, with possibly the overflow of retention, though there may have been backache, pelvic pain, and a discharge of blood prior to the mechanical obstruction of the neck of the bladder and the urethra. Occasionally the dysuria appears suddenly after straining at stool or other effort that increases intra-abdominal pressure. The presence of any of these symptoms indicates an immediate vaginal examination, whereupon the cervix is found just behind and perhaps above the symphysis, the body of the uterus distends Douglas's pouch, and may push the posterior vaginal wall forward and downward to the vulvar orifice. In neglected cases, or if the displacement is not spontaneously corrected, *incarceration* occurs. By this term is meant the imprisonment of the growing uterus in the pelvic cavity, where growth beyond a certain point is impossible. The bladder and bowels are so compressed that they may become gangrenous, and the pressure to which the uterus is subjected leads to congestion, inflammation, and gangrene. The symptoms of this condition manifest themselves



Figs. 152–155.—This abdominal supporter was designed by a mechanical engineer, T. S. Patterson, M. E. It proved so efficient that I recommend it. A–B shows the faulty lines of support of the ordinary supporters; C–D, the proper lines of support.

Old Method.—If five pounds' pressure is to be relieved at this point (A) by the old method, it will create, due to leverage, approximately a pressure equal to five or six times the original five pounds' pressure at location B, as B is one-fifth to one-sixth the distance from spine E as A is from spine E.

New Method.—Pressure to be relieved at location C is conveyed without being multiplied in a straight line to spinal column E, at location D, where the pressure is more easily carried.

after the third month, often in the fifth, and sometimes as late as the sixth month. They are: Occlusion of the bowel and urethra, with their associated symptoms; congestion, inflammation, and suppuration of the uterus, which may finally slough with the development of peritonitis, septicemia, or pyemia.

Terminations of Retrodisplacements when Artificial Means are Not Employed to Correct the Displacement.—Spontaneous reposition occurs in the majority of cases, though it should not be awaited in practice. It is more likely in retroflexion than in retroversion;[1] *spontaneous abortion* does not occur so frequently as one might expect, on account of the mechanical difficulty of emptying the uterus. In 115 cases abortion occurred in only 5 (Hermann). If abortion occurs in consequence of retrodisplacement of the uterus it is usually early in the second or third month; *incarceration* is the termination which the physician must have in mind as always possible, and against which effective preventive treatment must always be adopted; *expulsion of the uterus from the body as a whole* through a rent in the posterior vaginal wall is an effort on the part of nature to correct an impossible condition of affairs, but it can obviously be only partially successful. Rarely the disadvantages and dangers of posterior displacement of the pregnant uterus are overcome by "*sacculation of the uterus.*" In this condition the fundus and posterior wall of the uterus remain deep within the pelvis, while the growing fetal body is accommodated by an enormous distention of the anterior uterine wall.

Prognosis.—The outlook is always satisfactory as regards maternal life if appropriate treatment is adopted early. If the condition is overlooked or neglected, death frequently occurs. In fifty-one fatal cases the following, in order of frequency, were the causes of death: Uremia and exhaustion, rupture of the bladder, septicemia, peritonitis from inflammation of the bladder, pyemia, rupture of the peritoneum and of the vagina, errors in treatment, and gangrene of the colon.

Treatment.—The appropriate treatment is reposition. If the attempt is made early, manipulation will succeed. The bladder should first be emptied by a catheter. Its distention may be enormous. It may reach above the navel and may contain more than 6 quarts of urine.[2] If the distention of the

[1] Even with firm adhesions of long standing binding the uterus firmly backward I have seen spontaneous reposition take place.

[2] Fritsch reports a case with 3320 grams. Veit's "Handbuch der Gynäk.," vol. ii. In the University Maternity we have withdrawn by the catheter in fourteen hours 270 ounces of urine in a case of retroflexed gravid womb. In another case in the Philadelphia Hospital 244 ounces were drawn in twenty-four hours. A short glass catheter should never be used in these cases. A long silk, metal, linen, or soft-rubber catheter is preferable.

bladder is extreme, the whole amount of urine should not be drawn off at once. The sudden reduction of intravesical pressure has been followed by a fatal hemorrhage from the vesical mucosa. The patient being placed in the lithotomy position, the fundus uteri is pressed upward by two fingers in the posterior vaginal vault in the direction of one or the other sacro-iliac joint to avoid the projecting promontory of the sacrum. Failing in this attempt, the patient should be placed in the knee-chest posture and a repositor used to press upon the fundus. An anesthetic is always useful in difficult cases.

If the knee-chest posture fails, and there is no obstruction from an overfilled bladder, the cervix should next be drawn downward with a tenaculum, while at the same time pressure is made upward and to one side upon the fundus. If the attempts at reposition are successful, as they almost always are, a large-sized pessary should be applied until the growth of the organ maintains it in the abdominal cavity, and its increased size prevents its slipping back under the promontory. The artificial support should be removed midway between the third and fourth months. If the uterus is bound down by strong inflammatory bands, steady and long-continued pressure should be applied by means of large tampons in the posterior vaginal vault, inserted while the patient is in the knee-chest posture, by the aid of a Sims speculum, and renewed daily. A colpeurynter inserted in the Sims position, distended and allowed to remain for twenty-four hours, has succeeded when other plans have failed. Failing to secure reposition by these measures abortion should be induced, before the symptoms of incarceration appear.

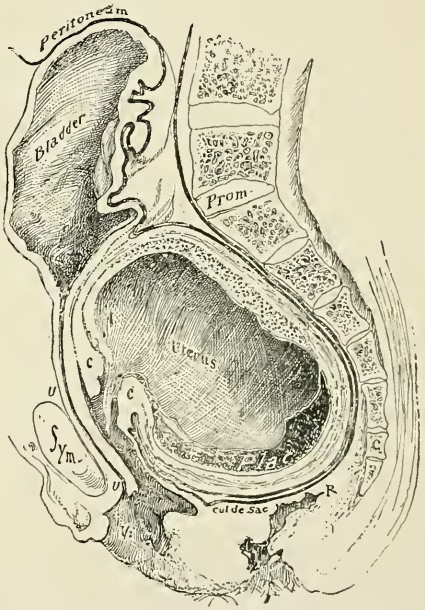


Fig. 156.—Frozen section of retroverted uterus of three and a half to four months. Death from rupture of bladder.

Treatment of Retrodisplacement when the Uterus is Incarcerated.—The physician's attention must first be directed to the

overfilled bladder. Catheterization is usually easy if a prostatic catheter is employed and if the physician recollects that the lower segment of the bladder as well as the urethra is enormously stretched and compressed,[1] making of the latter a canal perhaps more than five inches long (Fig. 156). A long flexible or semi-stiff catheter may be tried if the prostatic catheter cannot be introduced. If the insertion of the catheter is difficult, the cervix may be caught with a tenaculum and pulled backward, as suggested by Cohnstein, so as to relieve the pressure upon the urethra. If catheterization is impossible, suprapubic puncture of the bladder with an aspirating needle is always practicable and perfectly safe if done in an aseptic manner. After the bladder is emptied attempts at reposition should be made as previously described. If these attempts fail, abortion must be induced. If it is impossible to effect an entrance into the cervix for this purpose, it is justifiable to puncture the uterine wall through the vaginal vault, and thus draw off the liquor amnii. The uterus may now respond to efforts at replacement, or it may be possible to draw down the cervix and to dilate its canal, to make feasible the evacuation of the uterine contents. As a last resort, vaginal hysterectomy is justifiable. It is, indeed, the operation of election if the walls of the uterus are badly inflamed, have begun to suppurate, or are gangrenous. If the case is in the hands of an expert abdominal surgeon, celiotomy is recommended before resorting to the induction of abortion, for the purpose of replacing the uterus by direct intrapelvic manipulation.[2]

Lateral displacements include lateroposition, lateroversion, and lateroflexion. Lateroposition is usually a congenital defect, due to an abnormally short broad ligament, placing the whole uterine body more to one side of the abdominal cavity than the other. Lateroflexion is also congenital, due to imperfect development of one side of the uterine body, so that the imperfectly developed side acts like the string of a bow and bends the sound side on itself. Lateroversion is a tilting of the fundus to one side. Right lateroversion is the rule during pregnancy. These malpositions of the uterus complicate labor more than pregnancy (see Dystocia).

Prolapse of the Gravid Uterus.—*The causes* of this displace-

[1] Reed, "Am. Journ. Obstet.," 1904, claims that the inability of the bladder to empty itself depends upon a paralysis of its nerve supply. The Scotch verdict of "not proven" must still apply to this theory.

[2] Hermann, "Br. Med. Journ.," April 16, 1904, claims that the bladder alone need be attended to; that in 90 per cent. of cases the retroflexion will right itself if the bladder is kept empty. Even if this statement is true it is more sensible to replace the uterus after emptying the bladder, in order to avoid repeated catheterization and to guard against a possible failure of spontaneous reposition.

ment are: Impregnation in an organ already prolapsed;[1] retroversion, relaxed vaginal walls and outlet, and the increased weight of the uterus in the first few weeks of pregnancy; violent

Fig. 157.—Inversion of the vagina and prolapse of the cervix in a woman eight months pregnant.

straining or traumatism; acute edema of the cervix; a tumor in the pelvis pushing the uterus downward.

The spontaneous terminations are: Complete spontaneous reposition, which is most frequent; incomplete reposition, the uterus continuing in a state of partial prolapse to full term; failure of retraction, inducing incarceration, with possible gangrene of the uterus; failure of retraction, inducing abortion, which is

[1] A patient in my wards of the Philadelphia Hospital had had a complete prolapse for years. Copulation had occurred by means of an enormously dilated cervical canal and the woman had been impregnated in this manner. There was a spontaneous reposition of the womb before the third month of pregnancy.

most likely to occur, as there is no mechanical obstacle to the escape of the uterine contents. Pregnancy will not continue to term in a completely prolapsed uterus.

Treatment.—The appropriate treatment of a prolapsed gravid uterus is reposition after emptying the bladder and bowels and in the knee-chest posture, followed by the insertion of a globe pessary, retained by a firm T-bandage. If the uterus is incarcerated, attempts at reposition should be cautiously made, but if they fail, owing to adhesions and edema, abortion should be induced and the organ then replaced. If the uterus is infected it should be removed by a vaginal hysterectomy. If reposition is impossible owing to the presence of a tumor, vaginal or abdominal section is indicated to remove the tumor. These operations may also be required if reposition is prevented by adhesions.

The Pregnant Uterus forming a Part of a Hernial Protrusion.—This displacement occurs very exceptionally in inguinal and ventral, but never in crural, hernia, the uterus falling into the sac before or after impregnation. The ventral variety is most frequent, and may occur between abnormally separated recti muscles, or, more rarely, is seen on the lateral aspect of the abdomen. When it is associated very exceptionally with inguinal hernia, the pregnancy is apt to be in one horn of an abnormally developed uterus.

Treatment.—There should be an attempt at reposition. Failing in this, the cervix may be dilated and the hand inserted in the uterus, to perform version and extraction. The emptied uterus may then be returned to the abdominal cavity. The last resort is Cesarean section or amputation of the pregnant uterus. Winckel has reported such a case, with a successful issue.

Torsion.—A slight degree of torsion from left to right is physiological and constant. A more exaggerated degree may be due to some abnormal condition, usually inflammatory, near the uterus, which results in twisting it upon its longitudinal axis. An ovary may thus be brought in front and may be subjected to traumatism during manipulation of the abdomen. Extreme torsion of the pregnant uterus with lateral displacement has led to a mistaken diagnosis of extra-uterine pregnancy.

DISEASES OF THE UTERINE MUSCLE.

Rheumatism of the myometrium is rare, but is occasionally observed in women of rheumatic diathesis.

Symptoms.—Great pain, localized in the uterine walls, lasting throughout the latter months of pregnancy, and increased periodically by the intermittent uterine contractions. There may be a subacute fever. The therapeutic test is the most valuable factor in the diagnosis.

Treatment.—The administration of salicylates is immediately effectual.

Metritis is almost invariably acquired before impregnation. The disease exercises a most deleterious influence upon gestation, giving rise to a sensation of weight and heaviness in the pelvis, to an exaggeration of the reflex disturbances of pregnancy, and often resulting in abortion.

FIG. 158.—Fibromyoma and three and one-half months' fetus. Hysterectomy. (Author's case.)

Treatment.—Glycerin tampons may be packed in the vaginal vault to support the womb and to deplete it, although the treatment is very likely to induce abortion.

New growths complicate labor rather than gestation.

Fibromyomata grow rapidly on account of the increased blood-supply to the genitalia, and in exceptional cases some operative interference is demanded for the pain and pressure symptoms. In the majority of cases no treatment is required in pregnancy. Pinard[1] observed 84 cases of myoma in 14,000 pregnancies in the Baudelocque clinic. In 66 pregnancy was undisturbed; in 13 there was premature labor; in 5 abortion; in 4 cases intervention was necessary. I have been obliged to do myomectomy twice in pregnancy on account of excessive pain, to perform hysterectomy twice in the fourth month of gestation on account of pressure symptoms and kidney breakdown, and to per-

[1] "Ann. de Gyn.," Sept., 1901.

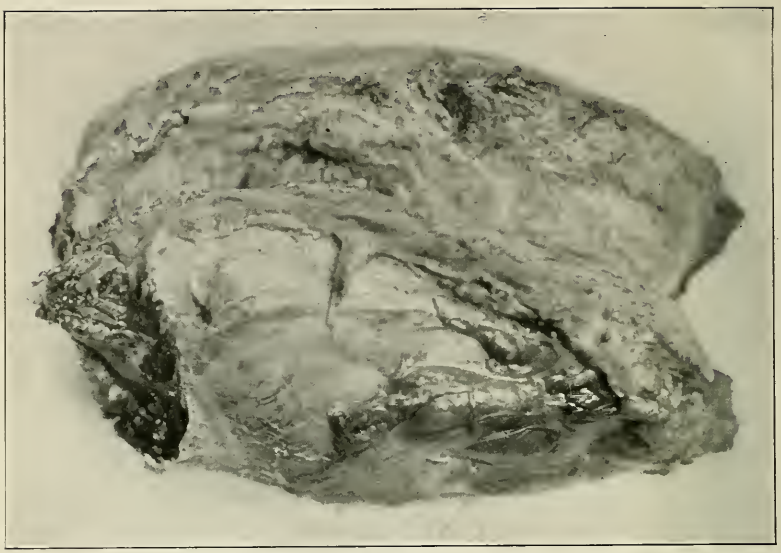


FIG. 159.—A fibromyoma of the round ligament in the inguinal canal. Weight, $6\frac{1}{2}$ ounces.

Fig. 160.—Fibromyoma of the right round ligament in the inguinal canal in a woman pregnant at term.

form Cesarean section at seven and one-half months, because of the embarrassment of heart action and respiration due to the enormous distention of the abdomen.

Fibromyomata of the round ligament in the groin rarely develop to a considerable size in consequence of the stimulus of pregnancy. They must be removed by an extraperitoneal operation after delivery. I have operated on three patients for this condition (Fig. 158 is a good example).

Ovarian cysts, especially dermoids, may grow rapidly in pregnancy, occasionally giving rise to such severe pain that ectopic gestation is suspected. The pedicle may be twisted and the tumor becomes gangrenous. There is usually an entire absence of subjective symptoms, except an uncomfortable distention of the abdomen, till the onset of labor or the puerperium.[1] Ovarian tumors should always be removed during early pregnancy if possible. The danger of the operation is no greater than at other times, and the proportion of miscarriages is scarcely increased above the average in all pregnant women (20 per cent.).

Diseases of the Cervix.—The inflammatory diseases of the cervix may exaggerate the reflex disturbances of pregnancy. Endocervicitis and interstitial cervicitis are found in too many cases of hyperemesis to be a mere coincidence. An annoying leukorrhea during pregnancy may have its origin in the cervical canal. Exacerbations of the inflammation may give rise to bloody discharges, especially at times corresponding to the menstrual period. Supposed menstruation, persisting throughout pregnancy, has thus been accounted for.

Treatment.—Applications of nitrate of silver solution, poured into a cylindrical speculum, give the best results in endocervicitis. Congestion, inflammation, and hypertrophy of the cervix are best treated by rest in bed and applications of glycerol of tannin tampons. All local treatment of the cervix, however mild, increases somewhat the risk of miscarriage. The patient should be informed of this fact and her consent should be obtained before the treatment is begun.

Cervical polyps and interstitial **cervical myomata** should be removed before labor begins; the former by ligation and section of the pedicle, the latter by enucleation (Fig. 161).

Acute edema of the cervix is due either to obstructed circulation or to an angioneurosis. It is very rare. Only 11 cases are recorded.[2]

Cancer of the cervix is rare in pregnancy: in 57,833 labors it was observed but 26 times (1 in 2000).[3] With very few excep-

[1] For the statistics of the child-bearing process, complicated by pelvic and abdominal tumors, see Dystocia.

[2] Seitz, "Zentralbl. f. Gyn.," No. 10, 1905.

[3] Sarwey, "Veit's Handbuch," III. 2, 489, 1899. See also Hense, "Zeitsch. f. Geb.," Bd. xlvi, page 68. Wertheim, Winckel's "Handbuch der Geb.," 2², p. 474.

tions it is found in women who have borne many children before (on the average, 7). The subjective symptoms are bleeding, foul discharge, and pain. The well-known objective signs are obtained by a specular and digital examination. It is a common mistake to overlook the existence of pregnancy before the third month in carcinoma of the cervix. The proportion of abortions is raised by this complication to 30 or 40 per cent. Missed labor has been reported several times; also spontaneous rupture of the uterus; placenta prævia is frequently found associated with a cancerous cervix. The existence of pregnancy hastens the progress and widens the extent of the disease in a remarkable manner. The prognosis is unfavorable: eight per cent. die undelivered, and 43 per cent. die during or directly after labor (Sarwey).

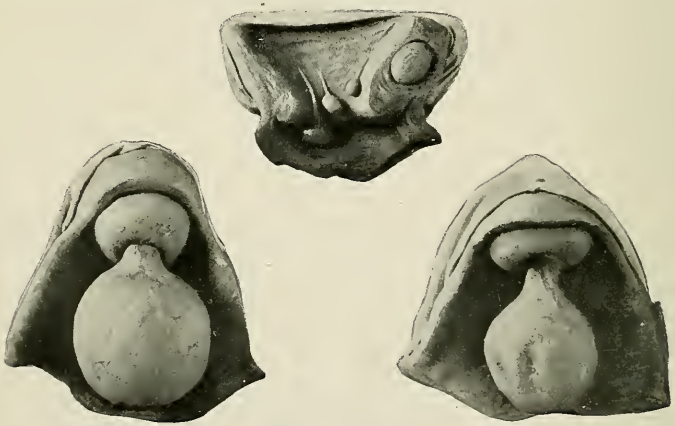


FIG. 161.—Mucous polyps of the cervix.

If the condition is operable when discovered, the uterus should be extirpated, preferably by the vaginal route, which is always practicable for the first four months. Twenty-nine such operations have been collected without a single death. Dührssen has proposed the evacuation of the uterus by the vaginal route after the fourth month, if necessary, by freeing the cervix from the vagina and splitting the anterior uterine wall, rupturing the membranes, and extracting the uterine contents, and then finishing the operation by the vaginal extirpation of the emptied womb. This procedure, he claims, is practicable at term.[1] It is preferable, however, to perform a combined or an abdominal panhysterectomy

[1] "Der vaginale Kaiserschnitt," Berlin, 1896; and "Ueber die Behandlung des Uteruscarcinoma in der Schwangerschaft," "Ceutralbl. f. Gyn.," 1897, No. 30, p. 942.

in the later months, associated with a Cesarean section, if the fetus is viable. In operable cases the fetus should receive no consideration. In inoperable cases it is better to await the viability of the child, and then to deliver it if necessary by abdominal or vaginal Cesarean section.

Diseases of the vagina are due to an increased blood-supply or to infection.

Vaginal leukorrhea is frequently an annoying complication of pregnancy. *Granular vaginitis* is usually found to be the cause, and there are quite often single spurs of condyloma growing from the vaginal mucous membrane. In very rare instances large masses of venereal warts may grow from the cervix, the vaginal vault and walls. (Plate 9.) These masses should be excised in the last month of gestation, by ligating the pedicle of healthy mucous membrane with catgut and cutting them off. The best treatment of vaginal leukorrhea is a single application of a thirty per cent. solution of carbolic acid in glycerin. The application is made on a pledget of cotton through a skeleton wire bivalve or a cylindrical speculum. It should be followed by an alcohol and water douche. The buttocks and vulva must be well greased with vaselin to prevent a carbolic acid burn. An easy treatment for the patient to carry out herself is to insert at bedtime vaginal suppositories of the milder antiseptics and astringents with glycerin as a base. A boracic acid douche is taken in the morning. Another successful plan of treatment is to pour into a cylindrical speculum a solution of nitrate of silver, gr. xx–f℥j, then to withdraw the speculum slowly so that successive folds of vaginal mucous membrane are bathed in it. A douche of weak salt solution should follow the application.

Specific infection with the gonococcus should cause anxiety on account of the eyes of the new-born infant and the infection of the mother after delivery, even should there be no great discomfort during pregnancy. The condition requires energetic treatment. A bichlorid douche, 1 : 2000, twice daily, and tampons dusted with tannic acid, give good results. For the bichlorid douche, a permanganate of potassium solution, f℥j : Oij (3.75 : 946 c.c.), every three hours, may often be substituted with advantage, and for the tannin tampons pledgets of cotton saturated with a 5 per cent. solution of argyrol. The vulva should be thoroughly washed with pledgets of cotton, tincture of green soap, and hot water at least once a day, followed by an irrigation of the vulva with permanganate solution poured out of a pitcher.

Pathogenic Micro-organisms in the Vagina.—A study of the vaginal flora during pregnancy, begun by Gönner and Döderlein,

has thrown additional light on the question of septic infection after labor. In the normal secretions, especially of virgins, there is a large nonpathogenic bacillus, which seems to have a destructive action upon other micro-organisms by producing an intensely acid environment (probably due to lactic acid). In pathological secretions the reaction is weakly acid, neutral, or alkaline; there is also in pathological secretions an increased amount of mucus, bubbles of gas, epithelial cells, and a large number of mixed micro-organisms. Out of 195 pregnant women examined by Döderlein, 44.6 per cent. had pathological secretions. There is great diversity of opinion among those who have investigated the subject as to the presence of disease germs in the vagina, such as streptococci, colon bacilli, and the streptococci. No one denies that these micro-organisms may be found on the vulva. It needs only common sense to admit that they must often be introduced into the vagina. Lack of personal cleanliness, coitus, a gaping vulvar

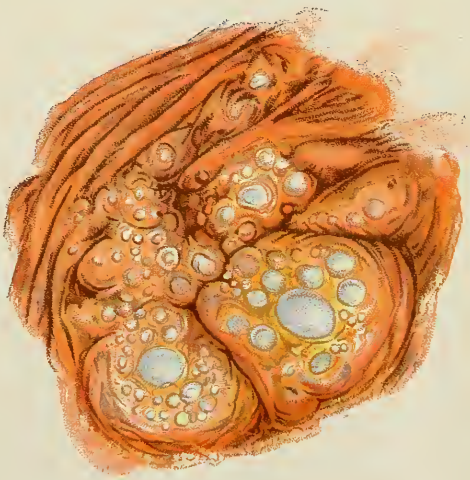


Fig. 162.—Emphysematous colpitis (Gebhard).

orifice, favor an ascending infection. Clinical experience, moreover, should convince any one of this possibility (see Puerperal Infection).

Colpohyperplasia cystica is an infectious disease of the vaginal mucous membrane in pregnancy, described by Winckel, in which little retention cysts are scattered throughout the hypertrophied mucous membrane in the interstices of the submucous connective tissue. In rare cases the fluid disappears from the cysts and its

place is taken by gas (*colpitis emphysematosa*), which Zweifel has demonstrated to be trimethylamin. If the vesicles are pricked they do not refill. This treatment, with a mild antiseptic douche (boracic acid), may be indicated. The disease disappears of itself after delivery. It has been ascribed by Eisenlohr to a short, unidentified bacillus, by Lindenthal to a bacillus emphysematosus vaginæ.

Mycosis of the vagina may be due to the leptothrix vaginalis or to oïdium albicans. The vaginal mucous membrane is reddened and at intervals displays patches of white membrane like thrush in the mouth of an infant. Another form of parasitic vaginitis is due to the trichomonas vaginalis. The cause of these inflammations may be detected by microscopic examination and they are easily curable by boracic acid douches and cleanliness.

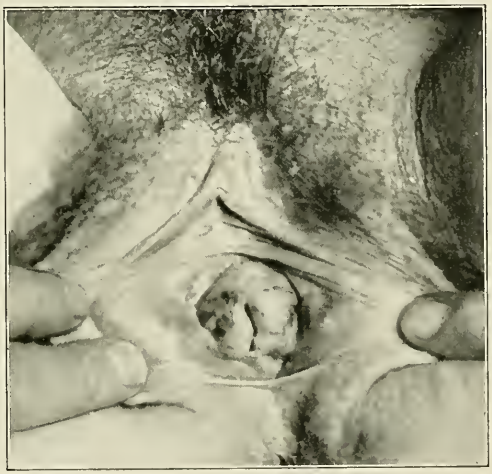


Fig. 163.—Hypertrophy of the urethral walls in pregnancy (author's case).

Varices of the vagina may be dangerous if the veins are large and their walls thin. The part should be guarded from traumatism, which might result in rupture of the distended veins and an alarming if not a fatal hemorrhage.

Polypoid hypertrophies of the vaginal mucous membrane, usually at the site of the carunculæ myrtiformes, may attain considerable size, causing discomfort during pregnancy, and possibly obstructing the canal in labor. I have seen one case of such enormous hypertrophy of the tissues surrounding the meatus urinarius that the urethra completely filled the vaginal entrance (Fig. 163).

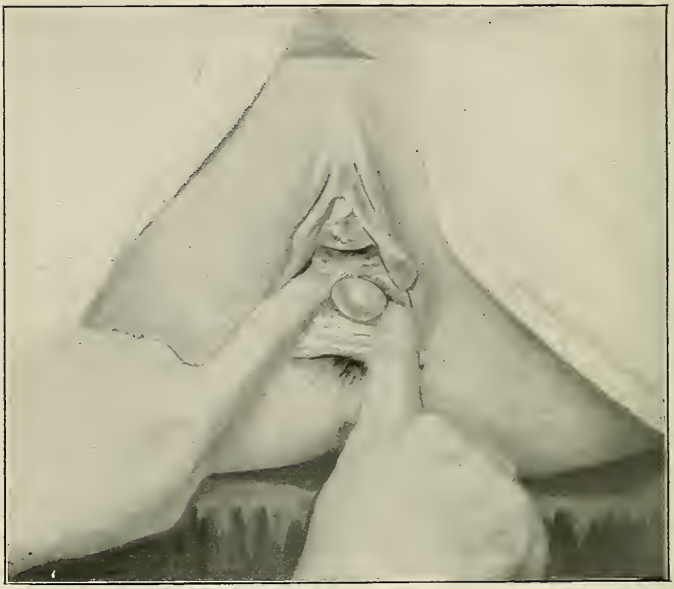


Fig. 164.—Vaginal cyst.

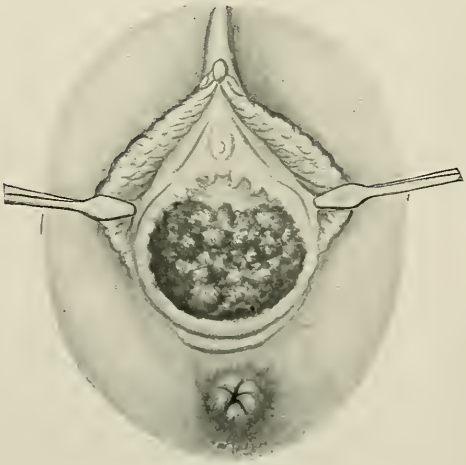


Fig. 165.—Primary carcinoma of vagina.

Suburethral abscess is an accumulation of pus in the anterior vaginal wall, bulging out at the vulvar orifice like a cystocele, and on pressure discharging the pus slowly and imperfectly into

the urethra through the opening of Skene's glands. The abscess should be opened through the vagina.[1]

Vaginal cysts (Fig. 164) grow larger in pregnancy, but they should not be operated on, as the hemorrhage is formidable and the operation may interrupt gestation. They may be punctured in labor and removed at the end of puerperal convalescence.

Cancer and sarcoma of the vagina (Figs. 165, 169), if operable, should be operated upon, regardless of the pregnancy, by enucleation of the vagina and by hysterectomy. If inoperable, a Cesarean section is indicated when the fetus is viable.

The diseases of the vulva are congestions, hypertrophies, neoplasms, or infection.

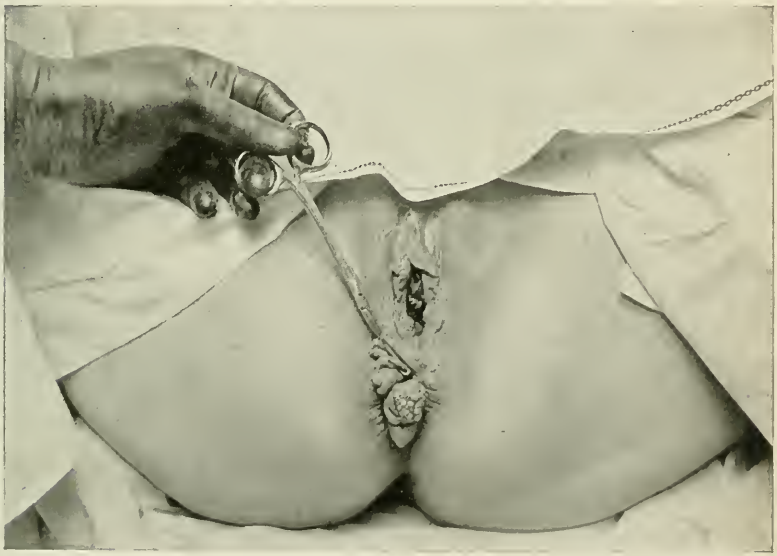


Fig. 166.—A mass of pointed condylomata protruding from the anus. Removed by the electrocautery clamp ten days *post-partum*.

Varices in the labia majora may attain a large size. They have been ruptured by muscular strain in an effort to preserve the equilibrium, by sitting down violently upon a hard substance, or by a kick. The hemorrhage is always dangerous, and has proved fatal.

Vegetations, pointed condylomata, or **venereal warts** of the vulva may reach excessive size in pregnancy. They are likely to give rise to an irritating, foul secretion. It is often possible to excise the growths. Profuse hemorrhage, however, is to be feared,

[1] "Archives de Tocol.," Oct., 1894.

Fig. 167.—Epithelioma of vulva.

Fig. 168.—Inoperable epithelioma of vulva.

and the operation might terminate pregnancy. An antiseptic and astringent dusting-powder is a good palliative treatment until the woman is delivered, when the growths should always be excised.

Sarcomata and carcinomata of the vulva, if operable, should be removed with the inguinal glands regardless of the pregnancy. If inoperable, Cesarean section is indicated when the child is viable.

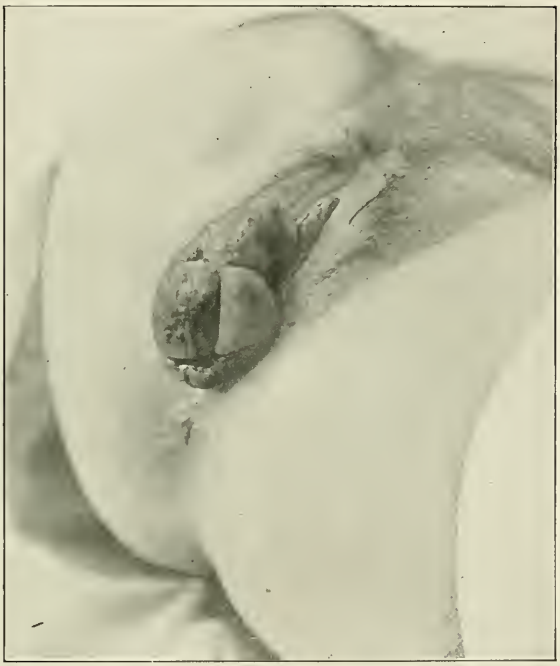


Fig. 169.—Sarcoma of left labium minus.

Pruritus vulvæ may be a neurosis or may be due to irritating vaginal discharges and to glycosuria. The disease is oftentimes most intractable to treatment. Antiseptic vaginal injections may be tried, or a wash of 2 per cent. solution nitrate of silver (Zweifel); menthol ointment, and other analgesic applications may be applied; very hot water, vinegar, and an infusion of tobacco are household remedies of some value. The best single remedy I have found is a strong solution of carbolic acid in cream (f℥ss to f℥j), followed by cold cream. In the worst cases the woman becomes almost maniacal. She may walk the floor all night, tearing the vulva with her fingernails until the labia are raw and her fingers are stained with blood. In such cases the induction of labor must be considered. If the pruritis persists after delivery and resists all

medicinal treatment, the excision of the five pairs of vulvar nerves is indicated.

Edema of the vulva may be unilateral or bilateral, and in some pregnant women reaches an extreme degree. It is due to the pressure upon the pelvic veins, to kidney insufficiency, or, in the unilateral form, to labial abscess. There are some women who develop a vulvovaginal abscess regularly in every pregnancy, and not at other times.

Treatment.—If the cause can be removed, the edema disappears. The treatment of kidney insufficiency removes the dropsy of the labia associated with that condition, as it does the other dropsies of the body. If the edema is due to pressure,

Fig. 170.—Venereal warts and the flat condylomata of syphilis combined.

rest in bed, with the occasional assumption of the knee-chest posture, often gives relief. If the edema does not yield to general treatment and to hot fomentations locally, the labia may be punctured. It should be remembered, however, that even this slight operation may terminate pregnancy. The vitality of the part, moreover, is so lowered that infection and even gangrene may follow the puncture. In the unilateral edema, associated with labial abscess, the vulvovaginal gland should be laid open in the last month of pregnancy, curetted, cauterized with carbolic acid, and packed with gauze, or else should be exsected entirely, which is the safest plan. The operation is bloody. Several large vessels must be clamped and tied. Otherwise it is

not difficult. The deep wound remaining after the removal of the gland is united with interrupted sutures. A drain of silkworm-gut strands must be laid along the bottom, and allowed to remain at least forty-eight hours. Some severe infections are due to the rupture of a vulvovaginal abscess during labor.

Fig. 171.—Varices of the vulva (author's case).

Periuterine Inflammations and Adhesions.—Old cases of pelvic adhesions may be benefited by massage and tampons. The most satisfactory results, however, are secured by appropriate treatment during the intervals between pregnancies. Fresh attacks of periuterine inflammation in pregnancy, depending upon oöphoritis and pyosalpingitis, are exceedingly dangerous. Unlikely as it may seem, a woman may be impregnated, though she have at conception a pyosalpinx and densely adherent tubes and ovaries. The inflammation of the adnexa may be lighted up afresh by the congestion of pregnancy. In such cases a septic peritonitis may

be averted only by a prompt abdominal section and the removal of the appendages.

Loosening of and Pain in the Pelvic Joints.—If the normal relaxation of the pelvic joints in pregnancy is carried to an abnormal degree, it may interfere with locomotion. The diagnosis is made by a vaginal examination, the patient, in the erect posture, taking a step or two, while the examiner holds his index-finger in the vagina against the posterior surface of the symphysis.

Treatment.—Application of a firm binder about the hips will usually make the patient comfortable. Rest in bed may be necessary in exaggerated cases.

The pelvic joints, especially one sacro-iliac, may be the seat of severe pain of rheumatic origin. The patient may be entirely disabled by her suffering. This pain yields immediately to antirheumatic remedies like the salicylate of strontium, and to no others.

Fig. 172.—Edema of vulva in the eighth month of pregnancy, due to pressure. Justominor pelvis. Fetal head unengaged above the pelvic brim. Swelling disappeared in a few hours after multiple punctures (University Maternity).

Breasts.—Mammary Abscess.—Its cause, course, and treatment are the same as when it occurs during the puerperium.

Eczema of the nipples may be very obstinate in its resistance to treatment. Relief may only be secured after delivery. Meanwhile the usual treatment for eczema may be tried with more or less success.

Mammary tumors may take on a very rapid growth under the stimulus of pregnancy. I have seen a simple adenoma the size of a walnut, quiescent for years, reach the size of a cocoanut during pregnancy.

DISEASES OF THE ALIMENTARY CANAL.

Mouth.—Caries of the teeth frequently troubles a pregnant woman. It is a common saying that for every child a woman loses a tooth. As a rule, prolonged and painful dental operations are inadvisable during pregnancy. Temporary work only should be done by the dentist, who should be acquainted with his patient's condition. The syrup of the lactophosphate of lime. f℥j (3.75 c.c.) t. i. d., internally, a mouth-wash of milk of magnesia, frequent brushing of the teeth, and rinsing the gums with diluted listerine should be prescribed for all pregnant women who display a tendency to dental decay. In 60 per cent. of pregnant women there is some hypertrophy of the gums.

Gingivitis.—In this disease the gums are spongy, inflamed, bleed easily, and are possibly ulcerated. The condition may obstinately resist treatment until pregnancy is concluded. Occasionally the gingivitis extends to a stomatitis, and rarely lasts through, and is aggravated by lactation, only disappearing when the child is weaned. The inflammation may extend down the esophagus to the stomach, producing dyspepsia and an obstinate vomiting. Astringent and cleansing mouth-washes, containing tincture of myrrh, give the best results in the treatment of this affection.

Toothache may develop with or without pathological changes in the mouth, and in the latter case may resist treatment. It usually subsides in the second half of gestation if it is a neurosis. If it is due to dental caries, temporary dental treatment should give relief.

Ptyalism occurs usually in the first half of pregnancy. The saliva is alkaline and ptyalin is lacking. The causes are the same as those of pernicious vomiting. They are: a neurosis, a reflex irritation of the sympathetic nervous system, or an auto-intoxication. Astringents, belladonna, chloral, etc., may be employed. It disappears usually in the later months, but may recur in each succeeding pregnancy. One of my patients had salivation in five successive pregnancies. Every night a large receptacle was placed by the bedside into which saliva was expectorated in astonishing quantities. A case is reported in which 1600 c.c. (51 oz.) was expectorated daily (Levoff).

The Stomach.—There is a physiological, an exaggerated, and a pernicious vomiting in pregnancy. The last is a serious disease, with a high mortality.

Pernicious vomiting is such an exaggeration of the physiological nausea and vomiting of pregnancy that the stomach becomes almost or quite unretentive.

Causes.—There are three causes for the pernicious vomiting of pregnancy: toxemia, reflex irritation, and a neurotic condition of the individual. The toxemic vomiting in early pregnancy is not yet satisfactorily explained. The most reasonable theory is an intoxication from the cells of the syncytium, the balance between hemolysis and syncytiolysis being disturbed. The toxemic vomiting late in pregnancy depends upon an imperfect elimination or oxidization of the products of fetal metabolism, and is usually associated with kidney insufficiency and albuminuria. The urine should always be carefully examined if vomiting appears late in pregnancy. The reflex vomiting is due to an irritation of the stomach from the distention of the uterus and an irritation of the latter's sympathetic nerve-endings, in consequence of the stretching of the uterine walls. It is, therefore, more common in primigravidæ, especially in elderly women; in twin pregnancies; in hydramnios; in chronic metritis or displacements of the uterus, especially if complicated by adhesions; in cases of chronically thickened, inelastic, or diseased cervices, and in a hyperesthetic or disordered condition of the nervous system. In one of my cases I had removed five fibromyomas by enucleation three months before impregnation. Another cause may be found in inflammation of the lining mucous membrane of the cervix or of the uterus. Engorgement or inflammation of neighboring organs, as inflamed tubes or ovaries, or an old or fresh appendicitis, increases the irritation of the distending womb, usually by reason of adhesions which bind it down. A pathological condition of the stomach, as gastroptosis, chronic gastritis, or gastric ulcer, naturally increases gastric irritability, so that the stomach feels acutely the reflex irritation of pregnancy. There may rarely be some pathological condition of the intestinal tract, as polypi or bands of adhesions, as a cause of pernicious vomiting. Immoderate indulgence in sexual intercourse is a not infrequent cause.

The neurotic vomiting appears in women of the neurotic type and may be neither reflex nor toxemic; but both reflex and toxemic vomiting are more likely to appear in neurotic women or are aggravated in such women.

Diagnosis.—The recognition of the cause may be difficult, but the diagnosis of the condition is easy. There is usually a subnormal temperature, but there may be fever; there is great emaciation, pallor, and loss of strength. The lips are dried and cracked, the tongue is brown and coated, and the breath foul. There is constant retching, and everything put into the stomach is either immediately rejected or comes up undigested in a short time. Whether anything is ingested or not, mucus and bile are vomited from time to time. A gastric ulcer is not uncommonly

the result of the disordered secretion of the stomach and the reduced vitality of its walls. In such cases the vomiting becomes bloody and the patient may succumb to repeated gastric hemorrhages, which she can not endure in her enfeebled condition. The most unfortunate mistake in the diagnosis of the pernicious vomiting of pregnancy is the failure to recognize the existence of gestation and the consequent belief that the emesis is that of hysteria, gastric ulcer, or cancer. Persistent vomiting in a woman of child-bearing age should always arouse a suspicion of pregnancy and should always indicate a vaginal examination.

An attempt has been made to make a differential diagnosis between reflex and toxemic vomiting by the percentage of ammonia nitrogen in the urine, an increased percentage indicating toxemia. The author's investigations so far do not support this contention. There is an increase of ammonia nitrogen in the urine as a consequence of any form of vomiting; a percentage of 17 has been found in a typical reflex case.

The treatment of hyperemesis gravidarum should be directed toward the cause if it is ascertainable or amenable to treatment. The various remedial measures required in individual cases may be conveniently studied under the following heads:

Hygienic.—This includes regulation of the diet, attention to the gastro-intestinal tract, to the woman's sexual relations, and to her mode of life. The physician should advise a light breakfast of tea and toast or milk, taken in bed before getting up, the patient lying flat upon her back. Resting quietly for a half-hour or so after the ingestion of light, simple food, the distressing nausea and vomiting usually felt on first rising in the morning may be entirely avoided. Sexual intercourse should be forbidden. Occasionally there is improvement when the sensation of swallowing is removed by a cocain spray of the fauces, or by injecting food into the stomach through an esophageal tube. Lavage of the stomach and of the colon has been beneficial. An electrical current applied over the neck and the epigastrium has occasionally been of service. Rectal alimentation must be resorted to in the worst cases, the enemata being non-irritating, so as not to provoke an exhausting diarrhea, partially digested, easily absorbed, and not administered in too large amounts or too frequently. Four to six ounces may be given three or four times a day, of liquid peptonoids, pancreatized milk, or peptonized beef-tea. The rectum should be washed out twice a day, and after the irrigation a pint of normal salt solution should be injected high up in the bowel for the relief of the distressing thirst that is a constant symptom. A tolerance of the stomach may at times be secured by allowing appar-

ently unsuitable articles of food if they are strongly craved by the patient. In all cases of true pernicious vomiting the patient must be confined to bed, the room should be darkened and kept absolutely quiet, and every atom of the patient's strength should be saved by careful nursing.

It must be remembered that the vomiting of pregnancy is sometimes a neurosis. Hence a strong nervous impression upon the patient or the establishment of a moral control over her, as in the treatment of hysteria, will often give brilliant results. A case of hyperemesis may be cured by making a vaginal examination, and the entrance into the patient's bedroom of a consultant may immediately check a vomiting previously uncontrollable. Again, a positive statement that a certain remedy would unfailingly stop the vomiting has made it immediately successful. In one case the appointment to induce abortion the following day so frightened the patient that she never vomited again.

The Medicinal Treatment.—The drugs that have been lauded as specifics in the treatment of hyperemesis include a large proportion of those in the pharmacopeia. The remedies most worthy of mention are: Iodin, gtt. j–ij (0.06 to 0.12 c.c.) in water; oxalate of cerium, subnitrate of bismuth, tincture of nux vomica, antipyrin, wine of ipecacuanha in small doses, menthol, hydrobromate of hyoscin, and cocain. The nerve sedatives—the bromids, chloral, and opium—are the most reliable (sodium bromid, gr. x (0.65 gm.), in aq. camph., ʒiv (15.50 gm.), four times a day, is a useful routine prescription). If the stomach is intolerant of drugs, recourse may be had to enemata of sodium or potassium bromid, gr. xl (2.60 gm.), and chloral, gr. xx (1.3 gm.), two or three times a day, dissolved in several ounces of water. Injections of normal salt solution in the bowel or under the breast have succeeded in some cases, it is claimed, by washing the blood, stimulating the kidneys, and thus combating a gestational toxemia. In the early stages of the disease calomel and salts may be effectual.

The Gynecological Treatment.—If the vomiting of pregnancy becomes exaggerated and resists the ordinary hygienic and medicinal treatment, a vaginal examination should be insisted upon. Various abnormal conditions of the pelvic organs may be discovered and must be treated. A displaced uterus must be replaced. If the cervix is engorged, thickened, or cicatricial, or if its canal is inflamed, applications may be made to it through a cylindrical speculum, a twenty-grain solution of nitrate of silver, for example, being poured into the speculum until the cervix is submerged in it. Multiple punctures of the cervix or the use of glycerin tampons may be considered, though these measures

would be employed at the risk of inducing abortion. Peroxid of hydrogen has been found useful poured into the speculum as just described. It is obvious that if applications to the cervical canal are made with an applicator and cotton, abortion might result. If there is metritis, with a large, heavy, inelastic womb, treatment may not accomplish much during pregnancy. Glycerin tampons may be tried if the knee-chest posture, rest in bed, and free purgation fail, but they may induce abortion. An adherent, displaced womb, with old or recent peri-uterine inflammation, is not infrequently responsible for a particularly obstinate and violent form of emesis. Pelvic massage, vaginal packing, or the colpeurynter must be resorted to at the risk of terminating pregnancy. An operation for appendicitis during pregnancy may be indicated. A strong solution of cocain, applied to the cervix and to the vaginal vault, has been beneficial in a few cases. Dilatation of the cervix with the fingers or with a bougie has occasionally been wonderfully successful. This so-called Copeman plan of treatment has many enthusiastic advocates, but experience has taught me that it is unreliable. Its occasional success is explained, I believe, by the nervous impression produced upon the patient.

The Obstetrical Treatment.—Induction of abortion or of premature labor should be regarded as the last resort, but it should not be delayed too long. If a patient retains absolutely nothing on her stomach and must be fed by the rectum ; if she vomits incessantly whether anything is put into the stomach or not ; if the pulse rises to 120 and the prostration is really alarming, abortion must be induced. As a rule, I do not continue rectal alimentation more than a week. There is one case on record in which rectal feeding was employed with success for almost two months, but this single instance should not encourage physicians to persist for an inordinate length of time in rectal alimentation. There are many deaths recorded of women fairly well nourished by food injected in the bowel, but fatally exhausted by incessant retching and vomiting.

It has been claimed that a high percentage of ammonia nitrogen in the urine indicating a toxemic vomiting calls for the induction of abortion. But as this condition may be an effect and not a cause, as it is found in reflex as well as toxemic cases, as a spontaneous recovery has been observed with a percentage as high as thirty, the physician can not be guided by this test in deciding for or against the radical treatment.

The mortality of the pernicious vomiting of pregnancy is high. Of 239 cases, 95 died ; of 57 cases treated by the usual means, 28 died ; of 36 cases treated by the induction of abortion, 9 died. I have induced abortion for hyperemesis fifteen times.

Two patients died. In one case I was called to see the woman in consultation when she was almost moribund. The induction of abortion proved too great a shock to her, easy and simple as the operation is. In the other case the religious scruples of the family prevented the termination of the pregnancy when I first advised it. Ten days later, the patient being obviously at death's door, the operation was demanded, but was performed too late.

The Intestines.—Constipation should be guarded against to prevent overwork of the kidneys. The small compressed pill of aloin, belladonna, cascara, and strychnin, kept in stock by all pharmacists, is a good routine remedy. My routine prescription at present is:

℞. Phenolphthalein,
Ext. cascar.,
Ext. colocynth. com. . . . . āā gr. j;
Ext. nuc. vom.,
Ext. belladonn. . . . . āā gr. $\frac{1}{12}$.
Sig.—In pill form at bed-time.

The weaker mineral waters, effervescent phosphate of soda, and pulv. glycyrrhizæ comp., may be used. A mild course of calomel followed by a Seidlitz powder is indicated, as a rule, about once a month. Active purges not only disturb digestion, but may interrupt gestation.[1]

Diarrhea.—When the ordinary astringent remedies fail to check a diarrhea in pregnancy, nerve sedatives should be tried. There is a nervous diarrhea of pregnancy due to the mechanical irritation of the intestines by the growing uterus.

Gastric and Intestinal Indigestion.—The latter is not uncommon in primigravidæ, and may give rise to such severe abdominal pains that a suspicion of extra-uterine pregnancy seems justified. These conditions, too, may be a neurosis, and may yield to valerian, bromids, and similar remedies after the ordinary treatment for dyspepsia has failed completely.

The liver is always under a strain in pregnancy. Toxins derived from the ovum or the embryo are conveyed by the maternal blood to the liver for oxygenation or preparation for elimination, mainly by the kidneys. Jaundice may result from a mild catarrhal condition of the bile-ducts, which may have existed before pregnancy. This class of cases is of little clinical importance. It should be remembered, however, that a serious condition may

[1] Herrgott reports a remarkable case of neglected constipation in pregnancy in which the urethra was obstructed and the bladder contained 4450 c.c. of urine; the posterior vaginal wall was pressed firmly against the anterior and the uterus was displaced upward and to one side by an enormous mass of feces, "Ann. de Gyn.," April, 1899.

develop in pregnancy as the result of excessive work thrown upon the liver—namely, an acute degeneration of the whole hepatic structure. Localized degenerations of the liver are seen in all fatal cases of eclampsia, and the toxins circulating in the blood in that disease may act upon the liver like phosphorus, producing acute yellow atrophy.

J. Whitridge Williams, in his studies of the liver in the toxemias of pregnancy, demonstrates a most interesting difference between the degeneration of the toxemia of early pregnancy with excessive vomiting and that of the toxemia of late pregnancy with kidney insufficiency and eclampsia. In the one the atrophic and necrotic process begins in the center of the lobule, extending to the periphery; in the other the process is reversed.

Treatment.—As the liver is called upon for extra work in pregnancy, care should be exercised not to impose too heavy a burden on it by heavy food, immoderate indulgence of a capricious appetite, alcoholic drinks, cold, or sluggish action of the bowels. Simple catarrhal jaundice is treated by regulation of diet and of the bowels, and by the administration of calomel to secure a free discharge of bile. The graver form of hepatic degeneration is likely to be rapidly fatal.

Appendicitis in Pregnancy.—Babler has collected 235 cases of appendicitis complicating pregnancy, labor, and the puerperium;[1] Renvall, 253.[2] The author's experience with the operative treatment of appendicitis in pregnancy has taught him the following lessons: (1) If the patient has an attack of appendicitis during early pregnancy, especially if she has had an attack before, operation should be advised. It is easy in the first half of pregnancy and should not endanger the continuance of gestation. An operation after the fifth month, on the contrary, is much more difficult, and if an attack occurs late in gestation, in consequence of intense congestion and increased intra-abdominal pressure, it is likely to be very severe, with early perforation and virulent peritonitis. (2) If there is reason to suspect suppuration, the median incision is required in operations after the fourth month; the uterus should be lifted out of the abdominal cavity to detect possible areas of suppuration deep in Douglas's pouch or on the left side. If there is no suppuration or peritonitis, the lateral incision is much better and safer. (3) If it is necessary to deliver the uterus from the abdominal cavity after the seventh month, it should be emptied by a Cesarean section before it is replaced in the abdominal cavity. (4) Diffuse suppuration and the necessity for drainage is not neces-

[1] "Perforative appendicitis complicating pregnancy." Journ. Am. Med. Assoc., Oct. 17, 1908.

[2] "Mitteilungen aus der Gyn. Klin. des Prof. D. Otto Engström," Bd. vii., H. 3, Berlin, 1908.

sarily incompatible with recovery or the continuance of pregnancy. In one of the author's cases at four and one-half months, the woman recovered and went to term.

Hemorrhoids.—The pelvic congestion of pregnancy and the mechanical interference with the circulation by the bulk of the gravid uterus predispose to hemorrhoids, and aggravate them if they antedate conception. Palliative treatment alone is permissible. An ointment of equal parts of ung. gall. and ung. stramon. will be found serviceable. Cocain, lead salts, and opium may also be useful. Rest in the horizontal posture, the knee-chest posture several times a day, and the routine use of laxatives may be necessary. As in all cases of hemorrhoids, the bidet gives great comfort.

DISEASES OF THE URINARY APPARATUS.

Examination of the Urinary Tract and of the Urine.—Cystoscopy and Catheterization of the Ureters is required for many complications and consequences of the child-bearing process. Two cystoscopes are needed, one for water, the other for air distention of the bladder. I find the Tilden Brown best for the former, the Elsner cystoscope best for the latter. In using the

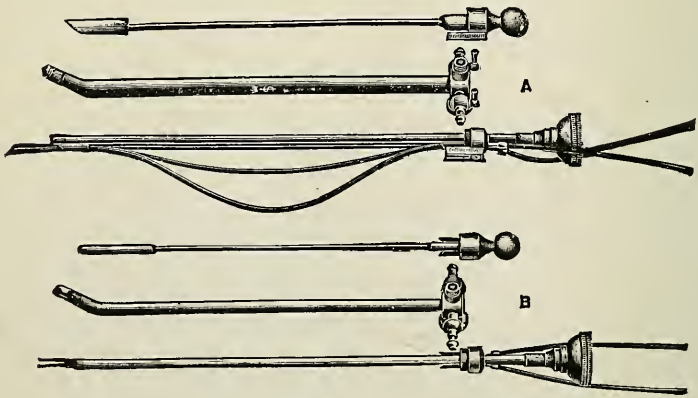


Fig. 173.—F. Tilden Brown's ureter-catheter cystoscope.

water distention instrument the bladder should be irrigated and filled with an oxycyanide of mercury solution (1 : 5000). For the air distention, the position indicated in Fig. 174 is necessary. With either cystoscope the catheterization of the ureters is easy, but the air distention is impracticable late in pregnancy. In looking into a pregnant woman's bladder, allowance must be made for the extreme distention and multiplication of the blood-vessels, which

under any other circumstances would be pathological. If it is necessary to obtain the urine from the two kidneys separately and the urethral catheters cannot be used, or urine does not flow from them satisfactorily, the Luys's segregator should be used. For the

Fig. 174.—Position of patient for air distention cystoscopy, requiring long leg supports, set further back in the author's operating table than in the ordinary Edebohl position. The body held in position by shoulder clamps.

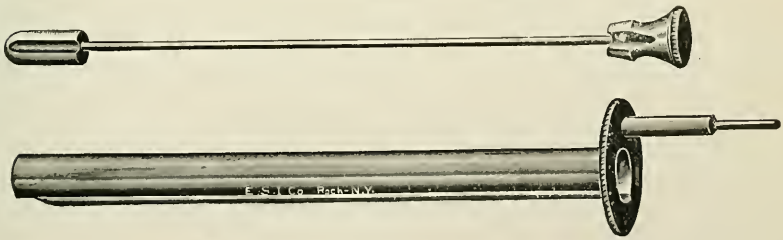


Fig. 175.—Urethroscope and its obturator.

examination of the urethra the instrument shown in Fig. 175 will be found most satisfactory.

The urinalysis ordinarily required in the child-bearing woman is described on p. 188. If more complicated or delicate inves-

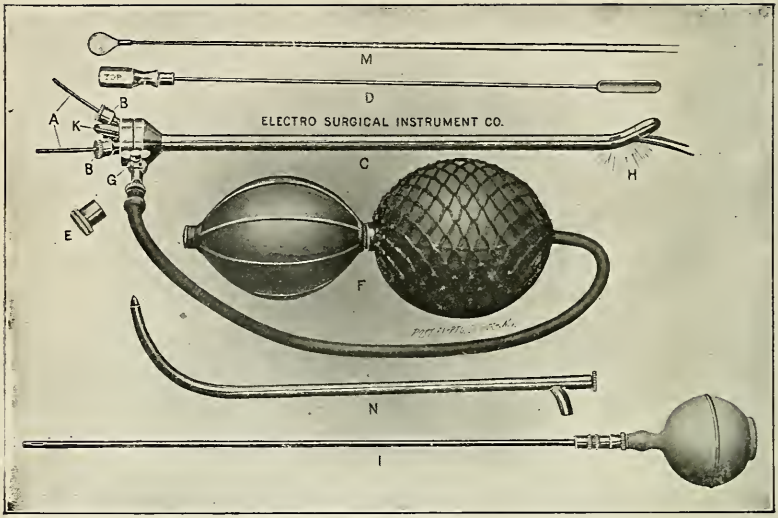


Fig. 176.—Elsner's ureter cystoscope: A, Catheter; B. catheter carrier tubes; C, cystoscope; D, obturator; E, window; F, dilating bulbs; G, stop-cock; H, lamp; I, irrigator and aspirator; K, current attachment; M, Elsner stiletto probe; N, cocain applicator.

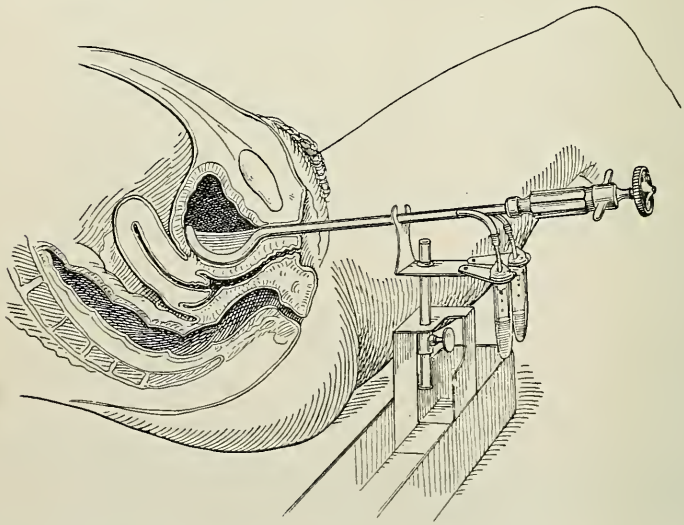


Fig. 177.—Luys's instrument for the intravesical separation of the two urines.

tigations are necessary, the student is referred to special manuals on the subject.

Kidneys.—The Kidney of Pregnancy.—There is a pathological condition of the kidneys so frequently developed in pregnancy

(fifty-eight out of seventy, Fischer[1]) that it deserves the name of "kidney of pregnancy."

Pathology.—There is anemia with fatty infiltration of the epithelial cells, without acute or chronic inflammation.

Etiology.—The causes of the common changes in the kidney during pregnancy are still obscure. They have been attributed to pressure on the renal blood-vessels, to the direct compression of the kidneys by the gravid uterus, to a serous condition of the blood in pregnancy, to the influence of the weather, to pressure upon the ureters, and to spasmodic contraction of the renal arteries. It is most likely that the condition is due to a diminution of the blood-supply, most probably brought about by increased intra-abdominal tension and by a contraction of the arterioles in the kidneys, due to the irritation to which they are subjected by the products of metabolism contained in superabundance in the blood of pregnant women.

Symptoms.—There is often albuminuria in advanced degrees of the condition. Hyaline and granular casts, with epithelium filled with fat, may be found. The kidneys may prove physiologically insufficient, and there may appear all the symptoms of renal insufficiency observed in true nephritis.

Frequency and Course.—About six per cent. of all pregnant women have albumin in the urine in decided amounts, though a vastly larger proportion show some degree of the kidney of pregnancy, if there is an opportunity for a postmortem examination. Albuminuria occurs most frequently in primigravidæ. The kidney disturbance runs a subacute course, manifesting itself most plainly in the latter months of gestation. It may influence the general health, the course of pregnancy, and the occurrence of eclampsia, just as inflammatory renal diseases would do. The renal insufficiency exerts a malign influence upon the fetus, also, especially in the production of placental apoplexies. If the mother becomes uremic, the fetus is also poisoned and rarely survives its birth more than a few hours. The dangers to both mother and child are greatest if the condition develops suddenly. The renal insufficiency of the kidney of pregnancy disappears with the cessation of gestation.

The treatment is practically the same as for true nephritis, so that the management of the kidney complications of pregnancy will be considered without reference to the cause of the kidney insufficiency.

Acute and Chronic Nephritis.—These diseases may occur at any time during pregnancy, with their usual symptoms. The

[1] "Prager med. Wochens.," 1892, No. 17.

extra amount of work thrown upon the kidneys during pregnancy makes the prognosis of kidney diseases graver than at other periods of adult life, and a more energetic treatment may be demanded in the pregnant than in the non-pregnant woman. Premature expulsion of the ovum and outbursts of eclampsia are frequent. Chronic nephritis may be acquired before or during pregnancy. Acute nephritis or a sudden insufficiency of the kidneys may be the result of exposure to cold, wet feet, sitting in a draft when overheated, or a single gratification of a ravenous appetite.

Differential Diagnosis between True Nephritis and the Kidney of Pregnancy.—If the kidney disease existed before pregnancy, well-marked symptoms will develop in the earlier months. The appearance of the first symptoms after the sixth month usually justifies the assumption that the disease has had its origin during pregnancy, and is nothing more than the temporary disturbance of that condition. I have, however, seen eclampsia break out in the last month of pregnancy or during labor in a woman who had a history of violent headaches and scanty urination for two years before conception, and in another who had had scarlet fever during girlhood. In both these women there was probably a latent nephritis, though there was not a sign of it in pregnancy until the onset of the convulsions. The following differential signs may aid one in the diagnosis of a doubtful case:

Chronic Nephritis.	Kidney of Pregnancy.
The history may point to its existence before pregnancy.	The history would indicate that the kidneys were normal before conception.
Quantity of urine increased and its specific gravity low; but these conditions are normal in pregnancy.	Quantity of urine likely to be increased and its specific gravity is low.
Sudden diminution in quantity may appear.	Sudden diminution possible, as in true nephritis.
Occasional presence of albuminuric retinitis.	Does not appear in the kidney of pregnancy, so far as my observation goes.
The symptoms of kidney insufficiency—albuminuria, edema, somnolence, headache—apt to be pronounced in the earlier months.	Do not appear, as a rule, until after the sixth month of gestation.
The autopsy shows inflammatory changes, chronic or acute.	Anemia and fatty degeneration of the kidney are found postmortem. No inflammatory changes, though the kidneys may become secondarily congested if convulsions have occurred.
Persists after delivery.	Disappears after delivery.
Casts appear early and in abundance.	Casts only in bad cases, not appearing usually until the other symptoms of kidney insufficiency have developed.

Treatment.—It is important to know, in any case of pregnancy, the condition of the kidneys; hence in all cases the urine should be repeatedly examined, at least every two weeks during the earlier months and once a week during the last month. If albumin appears, but if its quantity is small, if the total amount of urine in twenty-four hours is not diminished below the normal, if there are no casts, no history of a previous nephritis, and no symptoms of general systemic disturbance, dietetic and hygienic management may be sufficient, so long as the case is kept under careful observation. Meat should be eaten but once every other day. Large drafts of water should be systematically drunk. The greatest prudence must be exercised about adequate underclothing, exposure to cold and wet feet, and a laxative should be taken regularly if it is required. If the amount of urine voided is decidedly diminished, if casts are discovered and edema appears, the patient should keep her room or should be put to bed; the bowels must be kept freely open; the diet should be reduced to milk and Basham's mixture, or some other diuretic should be given. Three-grain doses of caffein and benzoate of sodium are satisfactory. If an exclusive milk diet is impossible, milk soups, a small amount of toast, the lighter vegetables,—squash, asparagus, beets, salad, spinach, etc.,—may be allowed in small quantities. If under this plan of treatment the symptoms grow progressively worse, especially if the blood pressure steadily rises, the termination of pregnancy is necessary. There is no disease of pregnancy with which the physician can so ill afford to trifle as this.

Obscurity of vision or actual blindness, demonstrating usually the presence of albuminuric retinitis, indicates the induction of labor or of abortion without a moment's unnecessary delay. Both ophthalmologists and obstetricians of experience are agreed that if the woman's vision, nay, if her life, is to be saved, pregnancy must be terminated at once. It should be remembered that if interference is long postponed, it may come too late. After the uterus is emptied eclampsia may occur, if the woman's system is allowed to become thoroughly saturated with the effete products of life activity in both mother and fetus, which the physiologically insufficient kidneys do not excrete. I am in the habit of depending mainly upon the quantity of albumin as a guide to determining the question of inducing labor. In every case of albuminuria in pregnancy I have daily examinations made with an Esbach albuminometer or by Purdy's method. If, in spite of confinement to bed, a milk diet, ingestion of large quantities of water, diuretics, and hot baths every other day, the albumin steadily or suddenly increases, I terminate pregnancy. A sudden diminution in the quantity of urine, excessive edema, intense

headache, failing vision, and somnolence would also decide the question indubitably in favor of terminating gestation. The quantity of urea excreted is not a reliable guide as to the degree of toxemia, the sufficiency of the kidney as excretory organs, and does not suffice as an indication for the termination of gestation. I have seen women with only 0.1 per cent. of urea and but 3 or 4 grams a day in perfect health, safely delivered at term, and others with 2 or 3 per cent. and over 30 grams a day profoundly toxemic. Cryoscopy has also failed to give information of value as to threatened toxemia or its degree. The only clinical test furnished by urinary analysis which aids us at present in anticipating toxemia or predicting its probable outcome is the quantity of albumin in the urine. In more than four-fifths of all the cases of grave toxemia an increasing albuminuria precedes or accompanies the systemic symptoms.

Renal tumors are rare. They are to be diagnosticated and treated according to the individual features of the case, but it must be borne in mind that any disease or abnormality of the kidney predisposes to insufficiency of excretion. The anatomically perfect kidney is likely, but not certain, to be physiologically sufficient. The unhealthy kidney will probably, but not certainly, be insufficient.[1]

Dislocation of the Kidney.—The right kidney is almost always the one affected. The displacement of the kidney is not infrequently associated with displacements of the gravid uterus. Abortion may result if the floating kidney happens to become twisted upon its pedicle. From the pressure to which the displaced kidney is subjected, and in consequence of interference with the renal circulation by torsion of the vessels, the kidney of pregnancy may develop. There sometimes occurs acute hydronephrosis with high fever, rapid pulse, great abdominal tenderness, sudden increase in the size of the kidney, and the peritonitic expression. Ice applications over the kidney relieved the patient in the single case under the author's observation. A congenital fixation of the kidney in the pelvis has been noted in the child-bearing woman.[2] It is usually the left (fourteen out of fifteen cases (Cragin)).

Diseases of the Pelvis of the Kidney.—*Pyelitis* has the history of all the infectious diseases in pregnancy; it is aggravated by the

[1] For two cases of hypernephroma associated with the child-bearing act see Noble, "American Gynecology" July, 1902; Boyd, "Am. Jour. Med. Sci.," June, 1902.

[2] Cragin has collected five cases in addition to his own. The author has reported a case not included in Cragin's statistics: "Am. Jour. of Obstet.," July, 1898.

condition, and reacts unfavorably upon it. It is a disease of the last four months of pregnancy. Premature expulsion of the fetus is apt to occur. Pyelitis is a comparatively frequent complication of pregnancy. The right kidney is most often affected for several reasons: The torsion of the uterus, its right lateral inclination, and the position of the presenting part in the right oblique diameter of the pelvis subject the right ureter to more pressure than the left; the common dislocation of the right kidney predisposes to congestion and to a kink in the ureter. The attack may be ushered in by a chill and there is often severe pain in the renal region. The fever may be high, but is usually moderate. The pyelitis may be due to lowered resisting power of the kidney the result of pressure upon the ureters, and is usually the result of a colon bacillus or a gonococcus infection, but the pathogenic bacteria may be staphylococci, streptococci, or tubercle bacilli. The infection usually ascends from the bladder, but may come from the blood. There is pus in the urine, but usually no cystitis. In obscure cases cystoscopy and catheterization of the ureters may be required.

The treatment is rest in bed on the side opposite the diseased kidney; ample draughts of water; salol and urotropin; an antitoxemic diet; an ice-bag over the upper outer segment of the abdomen and distention of the bladder by irrigation to excite peristalsis in the ureters and thus to drain the kidneys. Nephrostomy in unilateral cases may be considered. Even nephrectomy may be demanded if the suppuration involves the substance of the kidney, but such cases are very rare in pregnancy. They occur more frequently in the puerperium. The induction of labor is indicated if there are fever, large quantities of pus in the urine, a high leukocyte count, and a failure to respond to treatment. There is usually a spontaneous recovery after labor, showing the influence exerted by the pressure of the gravid womb upon the ureters.[1]

Hydronephrosis.—A displaced and adherent gravid uterus may occlude the ureters, with this result. The condition requires the reposition of the uterus.

A renal calculus is apt to induce abortion. Renal colic in pregnancy is to be treated in the usual manner, without regard to the patient's condition. The surgical treatment is not contraindicated.

Diseases of the Bladder.—**Irritability** is a functional disturbance, and occurs in an exaggerated degree in hyperesthetic individuals, who feel acutely the pressure of the gravid uterus, the pull upon the uterovesical ligament, and the congestion of all the pelvic viscera. Some degree of irritability of the bladder is seen, as a rule, in pregnant women.

[1] Kendirdjy collected 62 cases with 2 deaths, "Gaz. des hop.," April, 1904.

The treatment, if any is required, may consist of the reposition of a displaced uterus. If the disturbance is purely neurotic, nerve sedatives are indicated.

The incontinence of retention is one of the most distinctive symptoms of a backward displacement of the gravid uterus. There may be, however, a neurotic incontinence and a paretic incontinence in pregnancy.

Vesical hemorrhoids are due to an increased blood-supply to the part and an interference with the circulation by the pressure of the pregnant uterus. Hematuria may be a symptom. If the loss of blood becomes alarming, astringents may be injected into the bladder; the knee-chest posture should be assumed at frequent intervals, and the bowels must be kept freely opened.

Cystitis is more frequent after labor than in pregnancy; complicating pregnancy, it may be due to gonorrhea.

Vesical Calculi.—It is important that vesical calculi be discovered before labor. They should be removed through the urethra or by vaginal lithotomy during the last month of pregnancy, so that if labor is induced by the operation, the child shall not suffer by reason of its prematurity. It is unfortunate for the woman if she fall in labor with an undetected stone in the bladder. A vesicovaginal fistula is likely to be the result.

Anomalies of the Urine in Pregnancy.—**Polyuria** is an exaggeration of the physiological increase of the urine in pregnancy. It sometimes reaches an astonishing degree. One of my patients passed 220 ounces of urine a day. There is usually great thirst and the urine has a very low specific gravity, but should contain no albumin or sugar. The woman's health remains unimpaired, and it is unwise to attempt to diminish the excretion. After delivery, the polyuria disappears.

The urine may be diminished in quantity, may be high colored, and may have a high specific gravity, as the result of errors in diet and inactivity of the skin and bowels. This condition should never be regarded with indifference. It shows an increased strain upon the kidneys that may determine their breakdown. Meat should be temporarily excluded from the diet. The bowels should be kept open, and water must be drunk in large quantities.

Lipuria, occasionally observed in the pregnant woman, is explained by the unusual quantity of fat in all the tissues of the body, making its way even into the blood-current. An oiled catheter may be the source of the fat. This abnormality does not necessarily affect the woman's general health.

Chyluria occasionally, but very rarely, appears. It is of no pathological import.[1]

Peptonuria and acetonuria may develop in pregnancy in consequence of fetal death or without ascertainable cause. The latter condition is not infrequently associated with eclampsia. The characteristic odor of the woman's breath may be well marked.

Hematuria may be the result of vesical hemorrhoids. It may, however, indicate acute cystitis, ulceration, a vesical tumor, stone, acute nephritis, or some other disease of the kidneys predisposing to hemorrhage.

Mellituria in the pregnant woman ranks next in clinical importance to albuminuria. It has been found by some observers in from sixteen to fifty per cent. of cases, but this is not my experience. In the routine examination of the urine of all pregnant women under my charge, I do not find sugar by Fehling's test in one per cent. of the cases.

There are two distinct varieties of mellituria in pregnancy. One is due to absorption from the breasts; the sugar in the urine is lactose, and not glucose.[2] There are no systemic symptoms in this variety. The other is true diabetes mellitus, which is said to occur more frequently in pregnant than in non-pregnant women,[3] and if it exists before pregnancy is aggravated by the latter condition. In 7 out of 19 cases the disease determined fetal death, and in 4 out of 15 cases the mother died shortly after labor.[4] Stengel's[5] more recent statistics show that diabetes mellitus developing in pregnancy is not quite so dangerous as was formerly supposed if the patient is subjected to careful dietetic and medicinal treatment. In 27 pregnancies among 19 women there was a satisfactory recovery in 17. There were five deaths within a few days of the labor. Diabetes mellitus may appear in pregnancy with all its characteristic symptoms and may disappear after labor. I have one patient who regularly develops the disease in every pregnancy. It is not certain, however, to reappear in subsequent gestations.

Albuminuria.—The more exact and careful examination of urine in recent years shows a much larger proportion of pregnant women

[1] Meinert, "Centralbl. f. Gyn.," No. 16.

[2] In cases of mellituria a chemical or polariscopic examination should always be made, if possible, to determine the kind of sugar in the urine. Lactosuria requires no treatment. True glycosuria demands rigid dieting.

[3] The idea that diabetes mellitus is more likely to occur in pregnant than in non-pregnant women may have been due to the rather common appearance of lactosuria. In 157 cases of true diabetes mellitus in women, reported by Griesinger and Frerichs, only three were in pregnant women.

[4] Matthews Duncan, "On Puerperal Diabetes," "Obstet. Tr.," vol. xxiv, p. 256.

[5] "Univ. of Penna. Med. Bulletin," October, 1903.

with albumin in the urine than was formerly acknowledged. Volkmar, Fischer, Trautenroth, Saft, and Zangenmeister, in 920 examinations found an average percentage of 22.42, but the estimate varied from 5.41 per cent. (Saft) to 68.33 per cent. (Volkmar). The test employed was acetic acid and ferrocyanide of potassium and a mere trace of albumin was regarded as albuminuria. If more than a mere trace is demanded as proof of albuminuria, the older statistics averaging 6 per cent. are more accurate, and for the purposes of the clinician the latter standard is alone valuable. A faint trace, without increase, is of no moment. A decided amount has the most important significance, as the first premonitory sign of threatened toxemia in four-fifths or more of the cases.

DISEASES OF THE NERVOUS SYSTEM.

The Brain.—The inflammatory diseases of the brain are accidental complications of pregnancy and are rare; they exert no special influence upon gestation, nor do they modify its course, except cerebrospinal meningitis, which is infectious, and therefore has the same influence upon and is influenced in the same way by pregnancy as the other infectious fevers. That is to say, it is aggravated by the woman's condition and exercises a deleterious influence upon that condition.

Congestion of the brain predisposes to apoplexy, an accident which, serious as it is, has no influence upon the course of pregnancy or labor if the woman recovers from the cerebral hemorrhage.

The Spinal Cord.—Inflammatory diseases of this structure are also accidental complications, and are without influence upon pregnancy or labor.

Paralyses:—The woman may be the subject of paraplegia and yet pregnancy and labor are entirely uncomplicated. The latter process, indeed, is easier in such women. It would appear, therefore, that the spinal nerves exercise an inhibitory action upon the uterine muscle, the removal of which facilitates parturition.

The Peripheral Nerves.—Obstinate neuralgias appear in pregnancy, which may be little benefited by treatment, and only disappear after labor. It should be remembered that localized pains of a neuralgic character in the head, face, or breast are often indicative of toxemia in pregnancy. Multiple neuritis may have its origin in gestation, especially in alcoholic subjects.

The Neuroses of Pregnancy.—Chorea.—The milder grades of the disease are not uncommon in pregnancy. Buist [1] collected 225 cases. Sixty per cent. of the cases occur in primigravidæ. Heredity, chlorosis, rheumatism, and the existence of the disease

[1] "Trans. Edinb. Obst. Soc.," 1894–95.

in the patient's childhood are predisposing causes. Chorea is almost always aggravated by the coexistence of pregnancy, though in one case recorded the chorea ceased when the woman became pregnant.[1] In the graver variety of the disease premature expulsion of the ovum is apt to occur, followed by death of the mother in about one-fourth of the cases. Buist's statistics give 45 deaths out of 225 cases,—17.6 per cent. Insanity is not infrequently associated with or follows chorea in the child-bearing woman.

Treatment.—Fowler's solution, iron, nerve sedatives, change of air, and nutritious diet are indicated in the milder cases. The graver cases may actually require an anesthetic for the temporary control of the violent movements until the induction of premature labor can be effected, whereupon there is usually a spontaneous recovery unless the termination of pregnancy has been delayed too long.

Epilepsy is a rare complication of pregnancy. As a rule, epilepsy does not influence unfavorably the course of gestation. The convulsions are often absent during pregnancy, but make their appearance again during and after the puerperium or upon the reappearance of menstruation after the child is weaned. This disease is most likely to be confused with eclampsia (see Eclampsia). Cases have been reported in which the infant, after birth, presented the symptoms of the maternal disease and died.

Hysteria in its minor grades occurs frequently during pregnancy, but, as a rule, does not exert an unfavorable influence upon the course or duration of gestation.

Tetany may have its origin in pregnancy and may recur in subsequent pregnancies.[2] It is usually mild in type, ending in recovery, but it may possibly end fatally, in consequence of interference with respiration, by the firm contraction of the thoracic muscles. From recent experiments it appears that the parathyroids have some relationship with this disease and that calcium salts internally or parathyroid extract is the best treatment.

Uncontrollable hiccup and coughing are usually pure neuroses, and yield most readily, if they yield at all, to antispasmodic remedies, or to a profound nervous impression. The induction of labor may be necessary.

[1] In a patient in the Maternity Hospital, a young girl illegitimately pregnant, a chorea which she had had in childhood reappeared within a week of the fruitful coitus. I was obliged to induce labor in the eighth month on account of the severity of the symptoms.

[2] Neumann, "Zwei Fälle von Tetanie Gravidarum," "Archiv f. Gyn.," Bd. xlviii, H. 3; Meinert, *ibid.*, Bd. lv, H. 2, has collected 21 cases; also "Tetanie in der Schangerschaft," "Monatschr. f. Geb. u. Gyn.," January, 1904; Schmidlechner adds another case, "Zentralbl. f. Gyn.," No. 4, 1905, and Gross two more; "Muench. Med. Wochenschrift," No. 33, 1906.

Organs of Special Sense.—Eyes.—Failing vision should always indicate an examination of the urine for signs of advanced kidney disease. Occasionally, however, there occurs complete temporary blindness, associated only with anemia of the eye-ground, due to a reflex contraction of the retinal artery.

Hearing.—Disturbances of this sense are rare and are usually temporary, but they may be permanent. They are often inexplicable. Some anomaly of the external auditory canal may be found, as a hematoma, which was the cause in one reported case of deafness in a gravid woman. In my experience the hearing of a deaf person has been worse during pregnancy than at other times.

Psychical Disturbances.—Insanity.—*Frequency.*—Of all cases of insanity in women, about eight per cent. have their origin in the child-bearing process. About one in four hundred women confined become insane.

Predisposing Causes.—The nervous excitation of gestation in women predisposed by hereditary influence to mental breakdown, great reduction in physical strength, and prolonged mental strain or worry should excite the physician's anxiety for his patient's mind.

Exciting causes may be exaggerated anemia, as from prolonged lactation ; septicemia ; albuminuria ; profound emotions, as exaggerated fear of impending danger ; the remorse and shame of illegitimate pregnancy ; the grief of a deserted woman ; accidents, as hemorrhage ; great physical or mental exhaustion. Chorea, associated with insanity, results rather from the same predisposing or exciting causes, and should not be considered in itself as a cause of the insanity. In my experience, insanity in the child-bearing woman has almost always resulted from some profound emotion. One of my patients became insane after the death of her child ; another, because her husband deserted her ; a third, some days after her delivery, received a letter from her seducer casting her off. She fainted on reading it, became a raving lunatic that same night, and died of maniacal exhaustion within two weeks. Several cases were the result of futile efforts at delivery by operative procedures and repeated anesthetizations. A number of women under my observation have lost their minds from the shame of illegitimate impregnation.

Symptoms.—The form of insanity may be mania, melancholia, or a condition of profound lethargy, stupidity, and mental confusion. If a woman in this last condition is asked a question in a sharp tone of voice, there is a momentary flicker of intelligence in her face, but before the import of the question reaches

her brain, she is sunk again in her extraordinary apathy and indifference to her surroundings.

Time of Occurrence.—Most frequently mental breakdown occurs during the puerperium, next in frequency during lactation, and least frequently during pregnancy. Mania is the most, mental apathy or confusion the least, frequent form of puerperal insanity. Melancholia is commoner in pregnancy than in the puerperium.

The diagnosis of insanity is usually easy. It is, however, important to distinguish puerperal insanity from the temporary delirium of labor, delirium tremens, the delirium of fever, especially that of septicemia, and from preëxisting insanity.

The temporary delirium of labor is common. It is usually momentary, in the midst of the most acute suffering of labor, and varies in degree, from an outbreak of hilarity to violent mania.

Delirium Tremens.—Labor, like an accident or surgical operation, may precipitate an attack in hard drinkers. The history of the patient, and her symptoms, should demonstrate the nature of the case.

The delirium of fever in child-bearing women is commonly due to septic infection. It is frequently necessary to wait until the fever subsides to determine if it be the cause of the mental symptoms.

Preëxisting insanity is recognized by the previous history of the patient, if it can be obtained.

Prognosis.—About two-thirds of the women recover their reason in from three to six months; of the other third, from two to ten per cent. die of septic infection or exhaustion; the rest remain permanently insane.

The treatment is best carried out in an asylum. Many patients, however, will not be allowed by their families to enter an asylum. In such cases a modified rest-cure, combined with administration of iron, arsenic, and a nutritious diet, together with systematic exercise in the open air, will hasten the cure. The most careful supervision must be exercised at all times, to prevent the patient doing an injury to herself, her infant, or her attendants.

DISEASES OF THE CIRCULATORY APPARATUS.

Under this heading are considered those diseases of the heart, of the thyroid gland, of the blood-vessels, and of the blood, which have their origin in pregnancy or are much aggravated by that condition.

The Heart.—Valvular disease of the heart usually antedates

impregnation. It may, however, owe its origin to septic infection during the child-bearing process, or to rheumatism acquired after conception. A woman may have valvular disease of the heart without murmur or other clinical signs until she becomes pregnant, when the disturbance of the circulation occasions a loud heart-murmur and symptoms perhaps of heart-weakness. One of my patients has a heart-murmur in her pregnancies, which may be heard some distance from her body, but which is inaudible at other times.

Prognosis.—Abortion is induced in about twenty-five per cent. of all cases, as the result of placental apoplexies, or of the stimulation of the uterus to contraction by the accumulation of carbon dioxid gas in the blood. Pregnancy distinctly increases the danger of the heart-lesion. In fifty-eight serious cases, twenty-three died after a premature delivery of the child. In milder cases the prognosis is not grave, yet the woman's condition is by no means free from danger. The complications particularly to be dreaded during gestation are: a fresh outbreak of endocarditis, fatty degeneration of the papillary muscles, and, especially, congestion of the lungs. If the disease be of long standing and serious in character, it appears, from statistical studies, that about half the women die.[1] If there is good compensation, however, there may not be an untoward symptom, or, at most, occasional palpitations, some dyspnea, edema, and a tendency to renal congestion, with albuminuria.

Treatment.—The pregnant woman with valvular disease of the heart must be carefully watched. Her urine should be examined at frequent intervals. On the first appearance of symptoms pointing to inadequate compensation, digitalis or strophanthus must be administered, and it is commonly necessary to increase the dose as pregnancy advances. The bowels must be kept freely opened. Moderate exercise in the open air is an advantage, but rest in the recumbent posture must be ordered at frequent intervals during the day. Meat should be eaten sparingly on account of the likelihood of kidney breakdown, and extra precautions must be taken against suddenly throwing greater work upon the kidneys by chilling the skin. Flatulent dyspepsia is not infrequent in cardiac weakness. It should be carefully treated. It is almost unnecessary to state that the woman must avoid any sudden, violent physical effort, and should be spared any cause for mental excitement. Finally, pregnancy should never be allowed to continue longer than the thirty-sixth week in a woman who exhibits any symptom of imperfect compensation.

[1] This is not, however, my experience; with proper treatment I have no fear of heart disease in pregnancy (see Dystocia).

The Heart-muscle.—Suppurative myocarditis is only seen in connection with septic infection. Brown atrophy of the myocardium has been noted as a very rare complication of pregnancy; fatty degeneration of the heart-muscle may occur acutely in consequence of general systemic septic infection, or as a result of a gestational toxemia.

Graves' Disease and Goiter.—These diseases are unfavorably influenced by pregnancy. The former may have its origin in gestation. It predisposes the woman to uterine hemorrhages and may be a cause of fetal death. It may and usually will disappear after delivery. I have one patient in whom exophthalmic goiter with all its classical symptoms has recurred regularly in three successive pregnancies, the woman at other times being quite free from the disease. A goiter may take on so exaggerated a development during pregnancy that asphyxia is threatened, and tracheotomy may be necessary. In Müller's clinic in Bern it was found easier and better in two cases to resort to strumectomy. The dislocation of the thyroid from behind the sternum was immediately followed by relief of the asphyxia.[1] In a case of Graves' disease seen with Dr. Pittfield a very sudden enlargement of the thyroid was accompanied by remarkable slowing of the pulse instead of the tachycardia which had been marked for some years. There was probably pressure on the vagus. Graves' disease is likely to be complicated by albuminuria. The induction of labor must be considered, but is not usually necessary.

The Blood-vessels.—The disease of most clinical interest in these structures is varicose veins in the rectum, anus, broad ligament, bladder, vagina, external genitalia, the abdominal walls, and lower extremities. In the last there may develop a pressure edema, associated usually with varicose veins.

The causes of varices in pregnancy are changes in the investing muscular sheath of the veins, the increased quantity of blood, and mechanical obstruction to the circulation by the bulk of the growing uterus. Atheroma and degenerative changes may be found in the vessel-walls as the result of toxemia.

Complications.—There may be rupture, with possibly a fatal hemorrhage,[2] a severe interstitial bleeding, or extensive extravasation of blood under the skin. Thromboses and phlebitis, with suppuration and septic infection, may occur. As the result of itching and scratching, eczema or even erysipelas of the affected part may develop.

Treatment.—An elastic bandage or stocking should be ordered for varices of the legs. Small doses of heart-tonics are

[1] "Centralbl. f. Gyn.," No. 42, 1903.

[2] In 18 cases there were 11 deaths; Brunet, "Zentralblatt für Gyn.," No. 2, 1906.

often of service. Constipation must be avoided. The patient should be advised to lie down at intervals during the day. Absolute rest must be ordered in cases of thromboses, to prevent embolism. Lead-water and laudanum should be applied if there is inflammation. Abscesses along the course of a diseased vein should be opened early. A mechanical protection (soap-plaster) should be applied to the affected part to prevent the development of eczema or of erysipelas. Itching may be relieved

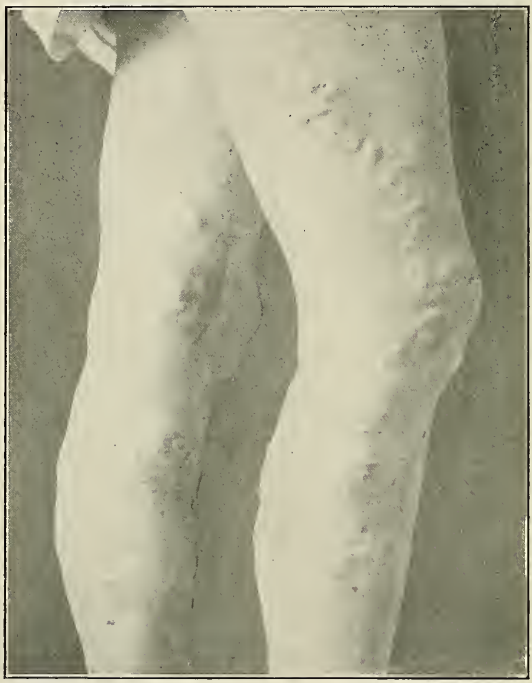


Fig. 178.—Varicose veins of the lower extremity in a pregnant woman at term.

by weak solutions of carbolic acid or by cocain. The woman herself should be instructed how to check hemorrhages, in case the distended veins burst.

Aneurysms are naturally unfavorably affected by pregnancy. The hypertrophy of the heart, the increased quantity of blood, and the mechanical interference with the circulation in gestation are all unfavorable factors. Such a case should be managed on the same principles that govern the treatment of cardiac complica-

tions. By this plan I have successfully delivered a young woman with an enormous aneurysm of the arch of the aorta.

The Blood.—Pregnancy may have a decided influence in producing those blood diseases which are characterized by a marked alteration in its constituent parts. Pernicious anemia and leukemia[1] may have their origin in gestation, and should they already exist, they are aggravated by the existence of pregnancy. Pregnancy should be promptly interrupted if these blood diseases are obviously progressing from bad to worse. The anemia of pregnancy may be so exaggerated as to appear pernicious, but arsenic, iron, and nutritious diet after delivery usually effect a cure. *Purpura hæmorrhagica* is apt to be rapidly fatal in pregnancy, which it always interrupts. The disease usually destroys the fetus before it is expelled. The maternal death may be due to postpartum hemorrhage or to sepsis.

DISEASES OF THE RESPIRATORY APPARATUS.

The Nose.—The sense of smell may be more acute, and peculiarities in this sense are developed, as abhorrence for certain odors, which may excite nausea and vomiting in neurotic individuals.

More important is the disposition to epistaxis, which may be so severe as to threaten life. Epistaxis, however, is a more serious complication of parturition than of pregnancy. It can only be checked by the rapid termination of labor. Meanwhile the nares should be packed.

The Larynx.—If a tumor, tubercular or syphilitic disease be present, there is a constant danger of edema of the glottis, which requires tracheotomy.

The Bronchi and Lungs.—**Bronchial catarrh** ordinarily is not harmful, but prolonged coughing may cause abortion, and the hydremic condition of the blood in pregnancy predisposes to pulmonary edema. The cough may have a neurotic element in it, and may be most persistent. In its treatment I have obtained better results from oil of sandalwood than from any other single remedy.

Pneumonia.—The symptoms of this disease are much aggravated by gestation, the mortality is increased, and in the vast majority of cases the fetus is prematurely expelled (see Pathology of Puerperium).

Emphysema is quite common. The symptoms in a pregnant

[1] Schroeder has collected ten cases and reports one, "Arch. f. Gyn,," Bd. lvii, H. 1, p. 26.

woman are aggravated, and abortion is apt to occur. In addition to the usual treatment inhalations of oxygen may be given to counteract the accumulation of carbon dioxid in the blood, which stimulates the uterine muscle to contract, and thus is the chief factor in determining an interruption of pregnancy.

Asthma in some women may only appear during pregnancy. In such cases the disease disappears the moment gestation is terminated. In other cases asthma may only appear in labor. In asthmatic subjects the attacks may be much aggravated by gestation and may obstinately resist all treatment. Radical change of air and scene has proved efficacious when all medicinal remedies have failed.

Phthisis Pulmonalis.—The influence of pregnancy upon this disease is most unfavorable, and in women predisposed to tuberculosis gestation may be the determining factor in lighting up an attack. There is a superstition prevalent among the laity that pregnancy is beneficial to a phthisical patient. This idea has its origin in the accumulation of fat commonly seen in the pregnant woman, which gives her a fictitious appearance of improved health. In reality the strain and drain of child-bearing exhausts the vitality of the tuberculous subject so seriously that her death is hastened by many months, and a pulmonary phthisis that might have been arrested becomes incurable. It is the duty of a physician to advise strongly against marriage and maternity in the case of a woman already infected with or predisposed to tuberculosis. If the patient is pregnant, the induction of labor should be considered, in some cases to secure the birth of a living child before the mother's death, in others to spare her the drain of the last four weeks of pregnancy and to insure her an easy labor. A tuberculous woman should not nurse her infant.

Miliary tuberculosis is rapidly fatal in pregnancy or shortly after delivery. It may be mistaken for septic infection. I have seen several cases in child-bearing women in which this mistake was made. The diagnosis is extremely difficult to make.

Pulmonary embolism is a possible accident in pregnancy.

Pleurisy exerts no deleterious influence upon, nor is it affected by, gestation.

Hemoptysis may occur in the latter months of pregnancy without phthisis or other lung disease. It is in these cases the result of "cardiac nerve-storms" in pregnant women of neurotic character. The cheeks are suffused, the eyes are bright, and the heart beats powerfully and tumultuously. The woman looks as though she had a high fever, but her temperature is normal. Chloral and the bromids will control the attack.

Diseases of the Osseous System.—**Osteomalacia of pregnancy** is a decalcification of the bones due to a peculiar osteitis and periosteitis, the result of malnutrition.[1] **Pott's disease,** in its active stage, is aggravated by pregnancy, and the mortality is much increased.

The infectious diseases are always more serious when complicating pregnancy, their symptoms being more severe and their mortality greater. Even **measles** at this time may become a deadly disease.

Upon pregnancy their influence is, as a rule, unfavorable. Sixty-five per cent. of **typhoid-fever** cases are complicated by abortion or premature labor. The development of the infant may be seriously affected in prolonged infectious fevers during gestation. Idiocy has been noted in a considerable number of cases.

Influenza is more serious in pregnancy than at other times. In 6 out of 21 severe cases abortion and premature labor occurred.[2]

Auto-intoxication or toxemia in pregnancy is still the subject of earnest study which has thrown much additional light on it, but has not yet enabled any one to speak dogmatically. There is an auto-intoxication in the first half of pregnancy, probably due to the growth and secretion of syncytial cells,[3] which produces a hemolytic agent and excites the production of an antibody, syncytiolysin. The chief symptom of the auto-intoxication of early pregnancy is exaggerated vomiting. The blood-pressure is low. In fatal cases a degeneration of the hepatic lobules is found beginning in the center and extending to the periphery (Williams). There is also an auto-intoxication in the second half of pregnancy, probably due to the reception into the maternal blood of the products of metabolism in the fetal body. The liver receives these products and breaks them up by oxidization into substances suitable for elimination, mainly by the kidneys. Either one of these organs may prove insufficient for the extra work thrown upon them, and thus toxins accumulate in the blood. As far as clinical observation goes, the kidneys are more frequently at fault than the liver. In less than a fifth of the cases toxemia manifests itself without precedent albuminuria. In more than four-fifths of the cases the symptoms of toxemia are preceded by well-marked albuminuria and other symptoms of kidney insufficiency. The systemic symp-

[1] See Deformities of the Pelvis.
[2] Möller, "Deutsch. med. Wochenschr.," No. 29, 1900.
[3] Behm, "Arch. f. Gyn.," Bd. lxix, H. 2.

toms of the toxemia of late pregnancy are high blood-pressure, a furred tongue, indigestion, vomiting, headache, pain in the epigastrium. There are usually scanty urine, edema, and albuminuria. The chief symptom may be a rapid pulse. Ultimately there is somnolence, failing vision, and finally an outbreak of eclampsia. Of all these symptoms high blood-pressure is the most constant. Auto-intoxication occasions sometimes a train of symptoms strongly suggesting miliary tuberculosis. There is irregular and prolonged fever, profound emaciation, and a rapid pulse. The patient may appear hopelessly ill and yet a termination of her pregnancy immediately cures her. In a typical case under my observation the symptoms had continued six weeks; the emaciation was extreme, and the patient was reduced in strength to the last degree. An accomplished clinician had made the diagnosis of miliary tuberculosis. The woman was in the last month of pregnancy. To save the child, I induced labor. To our astonishment the woman immediately improved, and was soon perfectly well.

The treatment of auto-intoxication has been considered under the head of the kidney diseases in pregnancy and of pernicious vomiting.

Syphilis.—Should infection occur at the time of impregnation, the primary sore and mucous patches in the vagina may assume an almost malignant character, ulcerating the vaginal mucous membrane, resisting treatment, and seriously complicating the puerperal state. Flat condylomata on the buttocks and in the natal folds are usually more extensive and numerous in pregnant women.

The *treatment* of all the infectious diseases in gestation is to be conducted with little reference to pregnancy. If abortion is threatened, the tendency should not be combated, as the termination of pregnancy is often of advantage to the mother, and at any rate can not be averted. The treatment of syphilis in the pregnant woman is dealt with in a preceding section.

Skin Diseases.—The following skin diseases are said to have their origin in pregnancy:

Impetigo Herpetiformis.—The favorite seat of the eruption is in the groin, around the umbilicus, on the breasts, in the axilla. The small pustules become crusts, around which new pustules develop until the entire surface of the skin is covered in the course of three or four months. Rigors, high intermittent fever, great prostration, delirium, and vomiting accompany the eruption.

The disease appears, as a rule, during the second half of gestation. Recent observation has shown that it is not absolutely confined to pregnancy. Of twelve cases ten terminated fatally, but the disease did not terminate gestation prior to the maternal death.

Herpes gestationis is characterized by pemphigoid efflorescence, exhibiting erythema, vesicles, bullæ, and scabs. It appears early in pregnancy, continues during gestation, and disappears

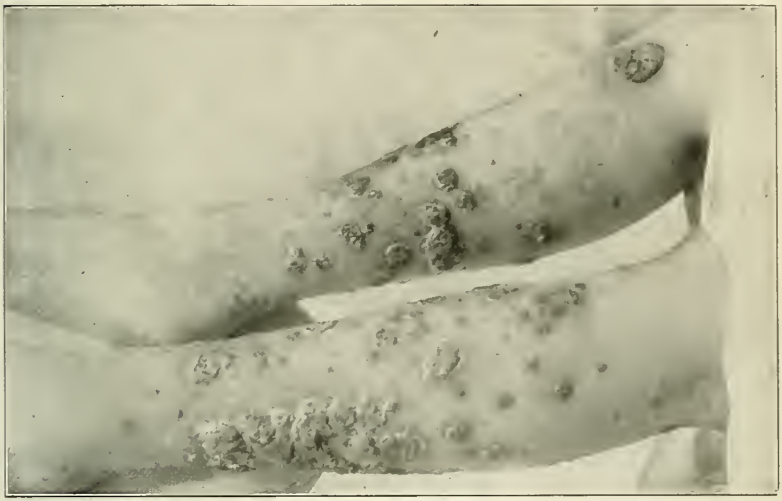


Fig. 179.—Herpes gestationis of legs, appearing as soon as the woman realized that she was illegitimately pregnant; first following the course of the nerves of the leg, but later coalescing.

during the puerperal state. Neurotic symptoms are associated with it, showing its probable nervous origin.

Pruritus.—Its usual seat is the external genitalia,—*pruritus vulvæ.* It may, however, in rare cases be general. *Causes:* The disease is often a neurosis, but it may depend upon irritating discharges, parasites, or glycosuria. *Treatment:* Rarely in general pruritus it may be necessary to induce premature labor, and in pruritus vulvæ the irritation is sometimes so great that the woman walks the floor the greater part of the night, tearing at the vulva with the finger-nails until the flesh is raw. The patient is brought to the verge of insanity in this affection, and the termination of pregnancy must be considered, but is not usually necessary. A common cause of pruritus vulvæ in pregnancy is an irritating vaginal discharge, and the most successful

treatment is a thorough disinfection of the vaginal mucous membrane by pouring into a cylindrical speculum a twenty-grain-to-the-ounce solution of nitrate of silver, then slowly withdrawing the speculum so that all the folds of the membrane are successively bathed in the solution. The treatment should be concluded by a douche of salt solution to neutralize the silver nitrate. In cases of purely neurotic pruritus nerve sedatives and a moral control of the patient, with a management on the lines of a rest-cure, are most effective. In the pruritus of glycosuria dietetic management is required. A boric-acid ointment on the skin protects it until the sugar in the urine is reduced in quantity.

There are three domestic remedies that enjoy a considerable reputation: very hot fomentations, vinegar, and infusion of tobacco. The last must be used sparingly and cautiously. The best medicinal applications are cocain, menthol, and carbolic-acid preparations.

The pruritus dependent upon seat-worms is treated by rectal injections of infusion of quassia.

Exaggerated Pigmentation.—Spots of quite dark pigmentation may appear on the breasts, thighs, and abdomen, as large as ten-cent pieces or a quarter of a dollar. The chloasmata on the face may be so exaggerated as to disfigure the countenance. This skin affection disappears after delivery, and is not amenable to treatment during pregnancy.

Loosening of the finger nails is a painful affection of pregnancy, apparently dependent upon malnutrition, and usually appearing in neurotic individuals. Nerve tonics, especially strychin, good hygiene, and a general tonic treatment do something to arrest the progress of the disease; but in the few cases under my observation (one recurring in three successive pregnancies) the treatment was only palliative as long as pregnancy continued.

Injuries and Accidents.—Severe injuries to a pregnant woman usually result in abortion. Among the most serious accidents of pregnancy are *rupture of varicose veins* in the external genitalia, the vagina, or lower extremities. One of the rarest accidents of pregnancy is rupture of the uterus. It may occur spontaneously in consequence of a previous Cesarean section, a myomectomy, or a healed rupture of the uterus at a former labor, the scar bursting open; it may be the result of chronic inflammation and degeneration of the uterine walls, reducing them to little more than connective tissue; or it may be due to traumatism. Spontaneous rupture of the uterus in pregnancy almost always occurs at the fundus, and frequently at the pla-

cental site. The accident is almost invariably fatal to both mother and child. It indicates an immediate abdominal section and usually a hysterectomy. A very serious accident of pregnancy is detachment of a normally situated placenta, with concealed internal hemorrhage (see Dystocia).

Surgical Operations.—If a pregnant woman's life or health is seriously threatened by delay until the completion of puerperal convalescence, surgical operations are justifiable, and permission may be given for their performance without great fear of an abortion if septic infection is avoided. Keen successfully amputated the thigh at the hip-joint for sarcoma in a woman five months pregnant, without interrupting gestation. Tumors of the pelvic organs may be excised with no more risk of abortion than any woman runs (twenty per cent.). It is even possible to remove a myoma from the uterine wall without inciting uterine contractions. I had the privilege of assisting Dr. Wm. J. Taylor in a myomectomy on a woman four months pregnant. The tumor was enucleated from the uterine wall, leaving a raw surface as large as the outspread hand. The woman was prematurely delivered, but it was some time after the operation, which apparently did not cause the miscarriage. In nervous and irritable women, however, slight operations, such as the extraction of a tooth, may interrupt gestation. The proper course, naturally, is to avoid operative interference in the pregnant woman, if it can be deferred without serious detriment to her. If, on the contrary, there is a positive indication for immediate operation, it should be undertaken without hesitation.

ABORTION, MISCARRIAGE, AND PREMATURE LABOR.

The term "abortion" is applied to the expulsion of the ovum before the fourth month. Premature labor signifies the birth of a fetus that is viable. For the expulsion of the ovum during the intervening time from the fourth to the sixth month of pregnancy a distinctive term is needed, as the process, in combining some of the features of both abortion and premature labor, presents a clinical picture different from either of them. To denote the interruption of pregnancy at this time the word "miscarriage" is used.[1]

[1] In speaking to patients the word "abortion" should not be used by the physician: it is resented as implying something criminal. Miscarriage means to the laity the interruption of pregnancy before the viability of the fetus.

The Causes of Premature Expulsion of the Ovum.—Many of the conditions which interrupt the course of pregnancy have been referred to. The death of the fetus; abnormalities and diseases of the membranes, including the deciduæ; pathological conditions of the placenta and apoplexies of the ovum; traumatism and certain diseases of the mother have all been noticed. But the maternal diseases have been regarded chiefly as to their effect directly upon the embryo, fetus, or ovum. There are, however, certain conditions of the mother having as their primary effect the active contraction of the uterine muscle, which results secondarily in the premature expulsion of the ovum, although the latter may be normal in every respect. Under this head come:

Irritable Uterus.—From clinical observation one must feel inclined to ascribe to every uterus a special temperament, which, as the case may be, is irritable, equable, or apathetic. It is notorious that some pregnant women are liable to lose the product of conception from a trivial cause. A long walk, coitus, congestion of the pelvis from any cause, ovaritis, irritation of the breasts or nipples, the extraction of a tooth, irritation of the vulva, a dose of some mild purgative, the jolting of a carriage; a misstep, especially while descending a staircase; not to mention a sea-bath, exercise on horseback, or dancing, have been followed by expulsion of the ovum. The mere sight of another woman in labor has been sufficient cause for abortion in some nervous women. In case the disposition of the woman to abort is known, the greatest care must be exercised to guard her from anything which might stimulate uterine contractions, and at the time corresponding to the menstrual period, when the uterus is particularly irritable and prone from habit to contract, the precautions must be doubled.

The opposite picture, while not so familiar, is occasionally seen. Some women can make the most violent exertion, can receive the roughest treatment, without bringing pregnancy to an end. English women have followed the hounds over the most difficult country in the early months of pregnancy without aborting. Sounds have been introduced into the pregnant uterus; intra-uterine injections have been given;[1] strong applications have been made to the endometrium; trocars have been plunged through the uterine wall;[2] a pregnant woman has been thrown violently from her carriage;[3] another fell from a third-story

[1] Scanzoni, "Lehrbuch d. Geb.," Wien, 1867, p. 83.

[2] Many cases are reported of tapping a uterus distended by hydramnios in mistake for an ovarian cyst or ascites.

[3] Tarnier and Cazeaux, 8th ed., p. 567. Also two of my patients.

window, fracturing her skull and breaking a leg;[1] a young girl, five months pregnant, cast herself from the Pont Neuf into the Seine;[2] in another, fifteen leeches were applied to the cervix of a pregnant uterus; Emmet's operation has been performed upon the cervix during the second month of pregnancy; ovariotomy and other serious surgical operations have been repeatedly performed, the spleen has been ruptured by violence and has been extirpated,[3]—all without inducing abortion or premature labor.

Spasmodic Muscular Action in the Mother as a Cause of Premature Expulsion of the Ovum.—Pregnant women affected with chorea, eclampsia, uncontrollable vomiting or coughing, epileptic, hysterical, or cholemic convulsions, or with tetany, are very liable to expel the product of conception prematurely.

Chorea.—Less than half of the women affected with chorea gravidarum go to term. Of 57 cases collected by Barnes, only 22 completed the full time of pregnancy. Bamberg's statistics of 64 cases show 33 arrived at term, and Spiegelberg, in 69 cases, saw only 29 delivered of mature infants.[4]

In a case under my observation the uterine muscle toward the end of pregnancy seemed to take part in the choreic movements that convulsed the muscles of the extremities. Through the abdominal wall the uterus could be felt firmly contracting at intervals of not more than a minute. Every contraction was extremely painful, but during the four days that this condition of the uterus lasted the os showed no signs of dilatation. The suffering finally became so great that labor was induced.[5]

Eclampsia.—The eclampsia of pregnancy in the great majority of cases determines the premature expulsion of the ovum. Frequently, no doubt, the life of the fetus is first destroyed; often, however, the immediate effect is seen in expulsive efforts of the uterus, due to asphyxia of the organ, to the irritating effect of the toxemia, or perhaps to the fact that the uterine muscle shares in the convulsive action of the whole muscular system.

Uncontrollable Vomiting and Coughing.—The constant violent action of the diaphragm in cases of uncontrollable vomiting during pregnancy often leads to the expulsion of the ovum. Of 51 cases of uncontrollable vomiting collected by Gueniot, 20

[1] A patient of mine in the Philadelphia Hospital. She recovered from her injuries, received at the fifth month of pregnancy, and was delivered at term.

[2] Juillard, "Nouvelles Archives d'Obstét. et de Gynec.," 1886, p. 1645.

[3] Savor, "Centralbl. f. Gyn.," No. 6, 1899.

[4] Hervé, "Thèse de Paris," 1884.

[5] For a report of the case see "Trans. Philadelphia Obstet. Soc.," Dec., 1887.

ended in abortion or premature labor.[1] A violent and persistent cough is also, in rare instances, the cause of premature expulsion of the ovum by the constant succussion in the abdominal cavity.

Epileptic, Hysterical, Cholemic, and Tetanoid Convulsions.—Attacks of epilepsy during pregnancy may be disastrous to the fetus, either killing it outright or bringing about its premature expulsion. Tanner mentions a case of hysterical convulsions which was followed by the expulsion of a dead fetus at the seventh month.[2] Cholemic convulsions occur more frequently than is generally supposed,[3] and they always interrupt pregnancy, either by the death of the mother or the expulsion of the ovum. Meinert[4] has collected 11 cases of a tetanoid condition in pregnancy, in 6 of which there was true tetany. In 2 of the 11 cases dead children were born, 1 prematurely at the seventh month, the other at term. In one other case the child was expelled at the eighth month, and in another eleven days before term.

Conditions of the Maternal Blood which Stimulate the Pregnant Uterus to Contract.—The poisons of all the infectious diseases in the maternal blood may excite active contractions in the pregnant uterus. Whether this is due to some irritative action of the micro-organisms, or to the development of the toxins, or to a diminution of the oxygenating power of the blood, as yet remains in doubt. The last condition explains the abortions occurring in pneumonia, as well as in cases of chronic heart disease, in which the circulation is much interfered with. It is possible also that strong emotions alter the blood in some way that would account for the action of the uterus when women have been terrified. But it is more likely that the action is analogous to that of the rectal and vesical muscles in cases of nervous defecation and urination. Baudelocque said in his lectures that, after the explosion of the powder-mill of Grenelle, he was called to see sixty-two women, either aborting or threatened with abortion. In all maternal diseases accompanied by fever the thermic irritation of the uterine muscle might be responsible for the expulsive efforts of the uterus.

Uterine Contractions Excited by an Abnormal Situation or Position of the Uterus.—Retroflexion and prolapse of the gravid uterus may induce abortion, for the uterus is unable to expand properly

[1] Tarnier et Budin, *op. cit.*, p. 59.

[2] "The Signs and Diseases of Pregnancy," London, 1867, p. 304.

[3] Stumpf, *loc. cit.*

[4] "Archiv f. Gyn.," Bd. xxxi, S. 444.

in its unnatural position. This is true likewise of pregnancy in one horn of a bicornate uterus.[1]

Perimetritis also, resulting in adhesions between the uterus and neighboring organs, or cellulitis, with plastic exudate in the broad ligaments, as well as diseases of a tube and ovary leading to adhesions, will, if pregnancy should occur, usually interrupt its course by interfering with the expansion of the gravid uterus. Appendicitis, with adhesions involving the uterine adnexa, may also have the same result. Fibromyomata of the uterine wall may act in the same manner, or else, by the congestion of the organ to which they lead, or by acting as a mechanical irritant, may stimulate the uterine muscle to contraction.

Overdistention of the Uterus as a Cause of Premature Expulsion of the Ovum.—If the uterus is unduly distended in hydramnios or in cases of multiple pregnancy,[2] especially when there are three or more fetuses, the distention of the muscle may irritate it to expulsive efforts.

In twin pregnancies, should one fetus die, the uterine muscle is occasionally stimulated to contraction, and the entire uterine contents are cast off, although the remaining fetus may be healthy and normal. In cows epidemics of abortion have been observed, which have been attributed to a specific form of micro-organism, said by Franck and Roloff to resemble the leptothrix buccalis.[3] Brocard[4] has also called attention again to this disease. It is improbable that the same disease can affect a woman, but in lying-in hospitals an epidemic of abortion or premature labor might occur from septic infection during pregnancy.

Clinical History of Abortion and Miscarriage.—Premature labor is not referred to. Its course, management, complications, and after-treatment may be considered in the description of labor at term, from which it does not materially differ.

The Frequency of Abortion.—It is almost impossible to arrive at a correct estimate of the frequency of abortion. So many women lose an impregnated ovum at an early period of its development, when they are not conscious of being pregnant; so many others fail to seek medical advice for an abortion uncomplicated by hemorrhage or decomposition of retained secundines, that almost all the estimates of the relative frequency of abortion and labor at term place the figure for the

[1] L. Mundé, "Case of Pregnancy in One Horn of a Double Uterus, with Successive Miscarriages," "Amer. Jour. Obstetrics," 1887, pp. 337, 346.

[2] See Doléris, "Nouvelles Archives d'Obstét. et de Gynéc.," 1886, p. 318.

[3] Schroeder, "Geburtshülfe," 8. Aufl., 1884, p. 460.

[4] "Recherches sur l' Avortement épizootique des Vaches," Broch., Paris, 1886.

former too low. Hegar[1] says that one abortion occurs to every eight or ten labors at term; but the estimate of Guillemot and Devilliers,[2] of one abortion to every four or five pregnancies, is more correct. Priestley[3] found that 400 women, among whom there had been 2325 pregnancies, gave a return of 542 abortions, or about one abortion to every four pregnancies. My own case-books also show this proportion.

Clinical Phenomena of Abortion.—The main clinical phenomena of abortion are: (1) Hemorrhage, (2) pain, and (3) the expulsion of more or less characteristic portions of an impregnated ovum. But these symptoms are rarely all manifested in a typical manner in every case. Pain may be absent, hemorrhage not excessive, and the whole ovum when cast off so small that it escapes unnoticed among the clots of blood that are discharged from the uterus. Such cases occur shortly after conception, and often pass for disordered menstruation, while the fact that pregnancy had begun is not suspected.

The duration of abortion varies. The French speak of an *avortement instantané* and Cazeaux gives an example of a woman who fell upon her buttocks, and, on rising, found on her linen considerable blood and a six-weeks' ovum. In some cases the expulsion of the ovum may occupy about the time consumed in a normal labor, but very frequently the process is much slower. Days, and even weeks, may be required for the uterus to get rid of its contents if left unaided to nature, and it is not rare for a fragment of the placenta or a portion of the uterine decidua to remain behind indefinitely, firmly attached to the uterine wall and often continuing to grow and develop, constituting within the uterus a true pathological new formation.[4] Of the two symptoms, pain and hemorrhage, the former is, in early abortions, usually the subordinate one. The hemorrhage is not often excessive, but may become alarming. The blood is not expelled in a steady flow, but from time to time as coagula. When the uterus discharges its contents the appearance of the substance expelled differs as the ovum is cast off entire with its shaggy, chorional coat, or surrounded by the decidua, which is often much thickened; as the embryo, enveloped by its amnion, is extruded without the decidua and chorion, or as the embryo, its delicate umbilical cord being ruptured, is expelled alone. The appearance of the embryo varies, of course, with the different periods of preg-

[1] "Beiträge zur Pathologie des Eies," "Monats. f. Geburtsh.," Bd. xxxi, S. 34.

[2] Tarnier et Budin, *op. cit.*, p. 474.

[3] "Pathology of Intra-uterine Death," London, 1887, p. 8.

[4] A condition described under the names "placental polyp," "polypoid hematomata."

Fig. 180.—Fetus in its membranes.

Fig. 181.—Dead embryo in a capsule of thickened decidua. Absorption of the liquor amnii.

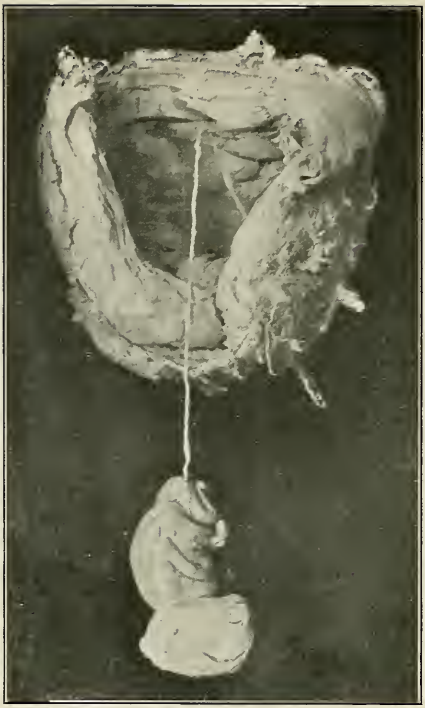


Fig. 182.—Young embryo, thickened decidua, and ruptured ovum.

Fig. 183.—Ruptured membranes, embryo, and newly formed placenta.

nancy: if still inclosed in its amniotic sac, a thin-walled, transparent vesicle may be found floating in the blood or imbedded in a clot, and within the sac the embryo is seen floating in the liquor amnii. In other cases the ovum resembles a ball of flesh, which, on being opened, discloses an embryo confined within a sac with very thick walls, composed mainly of greatly hypertrophied decidua. Or, again, the substance expelled from the uterus may be a fleshy mass, the deciduous membrane, in shape a cast of the uterine cavity, within which there is an empty cavity. The embryo in these cases has either died and been absorbed,

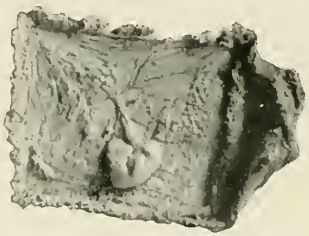


Fig. 184.—Embryo of about four weeks, with its membranes entire.

or else has been previously cast off unnoticed in the bloody discharge.

If the ovum proper is cast off entire,—that is, with its chorional covering intact, without adherent shreds of deciduous membrane,—it presents an appearance quite characteristic, especially if floated in water; the chorional villi show to the best advantage, giving the ovum much the appearance, except for its color, of a chestnut-bur.

Most frequently it is the embryo alone, or at most the ovum, in whole or in part, covered often by the ovular decidua, that is discharged, while the uterine decidua remains behind within the uterus.[1]

The retention of this membrane after abortion can not be regarded with indifference. The thickened uterine decidua is infected and decomposes, or else portions of the decidua attract an increased blood-supply, retain their original development, and even increase in size, forming new growths within the uterus which give rise to frequent and alarming hemorrhages or to persistent metrorrhagia.

It is this complication of abortion that often makes the prognosis uncertain, and is the main factor in raising the mortality

[1] Dührssen, "Zur Pathologie und Therapie des Abortus," "Archiv f. Gyn.," Bd. xxxi, H. 3.

after abortions as high as that of childbirth at term. Maygrier saw four deaths in 698 spontaneous abortions, but 25 in 44 criminal abortions.[1] In the Rotunda Hospital of Dublin, during the mastership of Dr. Johnston, 234 abortions occurred, with but 1 death, and that from heart disease.[2] But of 120 cases treated in the clinic and polyclinic of the Charité in Berlin, 2 died.[3] Of 82 abortions in the Obstetrical and Gynecological Institute of Florence,[4] 5 resulted fatally to the women,—a death-rate of 6 per cent. In the Charité at Paris (1883–86) there were 57 cases of abortion without a death; and in the Maternité, 153 cases with 1 death (Tarnier). In the Woman's Hospital of Bern, of 484 abortions, 4 ended fatally.[5] In 74 protracted abortions the uterine cavity was found infected in every case by pathogenic micro-organisms. In 12 cases there had been no digital examination.[6] In 15,000 abortions treated in the University clinic of Berlin, 450 women were seriously ill and 94 died.[7]

Diagnosis.—It may be necessary in cases of suspected abortion to determine the existence of pregnancy; that fact being established, it becomes necessary to distinguish between threatened abortion, inevitable abortion, and an abortion partially or wholly accomplished.

The Diagnosis of Threatened Abortion.—If a patient presents a history of suppression of the menses; if she has been exposed to the possibility of impregnation; if there are, in short, the signs of early pregnancy, and a hemorrhage occurs from the uterus, associated with more or less pain, a threatened abortion is probable. Irregularities in menstruation, the suppression of the function from causes other than pregnancy, and its reëstablishment by a profuse flow, accompanied by pain, arouse a suspicion of abortion. In these cases, however, the signs of pregnancy are absent and the os is not patulous. But if the symptoms should be due to an effort of the uterus to expel a polypoid tumor, the case may so closely resemble one of abortion that the diagnosis is only made after the expulsion of the uterine contents or the dilatation

[1] Doléris, "Statistique sur l'Avortement, Ann. de Gyn.," April, 1905.

[2] Lusk's "Obstetrics," 1886, p. 313.

[3] Dührssen, *loc. cit.* This same author mentions the statistics of 520 cases of abortion collected in the inaugural thesis of Lechler (Berlin). Half of these, treated by active interference, showed 4 deaths,—3 from intercurrent affections, 1 the result of abortion.

[4] Fasola, "82 aborti nel trienno, 1883–85," "Annali di Ostet. e. Gynecol.," March, 1887.

[5] "Swiss Dissertations," F. Moser, Bern, 1900.

[6] Hellendal, "Zentralbl. f. Gyn.," No. 27, 1905.

[7] Seegert, "Ztschr. f. Geb. u. Gyn.," B. lvii, H. 3, p. 344.

of the os. In cases of doubt the diagnosis should rest on abortion and the woman should be treated accordingly.

The Diagnosis of Inevitable Abortion.—It is always desirable to determine when a threatened abortion becomes inevitable, for if its prevention is no longer possible, the treatment should be radically altered. Unfortunately, the signs which usually denote an unavoidable expulsion of the ovum can not always be depended upon. If there is persistent hemorrhage, abortion will usually occur, but even in spite of a bleeding which may continue for a considerable time or return at intervals during the whole duration of gestation, the pregnancy may go on to term. If the cervix becomes markedly softened and the os dilates, the ovum will ordinarily be cast off; and yet the os has dilated sufficiently to admit two fingers, but has again retracted, and pregnancy has pursued its course. If portions of the uterine contents should be expelled, it would seem that abortion was surely inevitable; but Playfair, Charpentier, and Doléris have reported cases in which pieces of decidua were expelled from the uterus without the interruption of pregnancy. In Playfair's case four or five fragments of decidua, each as large as a fifty-cent piece, were cast off in the third month of pregnancy as a result of the introduction of a sound into the uterus; but the woman went on to term. The only two conditions which can be said to render the abortion almost inevitable are the rupture of the membranes and the death of the embryo; but even were it possible to ascertain with certainty, during the early months of pregnancy, that the membranes were ruptured or that the embryo was dead, cases might be recalled in which the liquor amnii was resupplied after puncture of the pregnant uterus with a trocar (Chiara), and after rupture of the membranes, and there has been a retention of the ovum after the death of the embryo for months or for an indefinite number of years. If the hemorrhage is persistent; if the os dilates; if there is felt presenting within the os a cystic tumor—the ovum;[1] if the pain is considerable; and, above all, if portions of the ovum are expelled, abortion may be pronounced inevitable. Tarnier[2] calls attention to a sign which is valuable as indicating an unavoidable abortion. This is the effacement of the acute angle formed anteriorly between the neck and body of a pregnant uterus. The disappearance of this angle indicates a contraction of the longitudinal fibers of the uterus and a descent of the ovum.

[1] It is well to bear in mind in this connection the possibility of the cervical pregnancy of Rokitansky, already referred to, of which several cases have been reported.

[2] Tarnier and Caseaux, vol. i, p. 574.

The Diagnosis of an Abortion Partially or Wholly Accomplished.—It is always important to determine, in a case diagnosticated as one of abortion, whether a part or the whole of the uterine contents has been expelled. It is necessary to examine everything discharged from the uterus; the clots should be floated in water, and should be carefully teased apart, when an embryo, alone or enveloped by its membranes, may be discovered. But frequently the embryo and ovum are so small that they are lost in the comparatively great volume of blood that surrounds them, or the discharges are removed from the patient and are not preserved. In such cases an internal digital examination ordinarily serves to determine the true nature of the case. The os is usually patulous; the finger, passing into the cavity of the uterus, detects shreds of deciduous membrane more or less closely attached to the uterine wall, and often a placenta, still adherent, or some portions of the fetal membranes may be plainly distinguished. If the abortion has been wholly accomplished,—that is, if all the uterine contents, including the hypertrophied decidua, have been completely expelled,—the uterus is firmly contracted, the os is small, and a digital examination of the uterine cavity is difficult or impossible. The diagnosis must depend upon the history of the case, upon the examination of the discharge, upon the enlarged uterus,—which does not at once return to its normal size,—upon the lochial discharge, and upon the establishment of the milk secretion. The last phenomenon is all the more marked the later the date of pregnancy at which abortion or miscarriage occurs, and is more evident in multiparæ than in primiparæ; but Budin has observed a young girl in whom the menses were suppressed for only twenty days, and then returned as a profuse flow, who exhibited shortly afterward all the signs of commencing lactation.

In some cases the disappearance of all the presumptive signs of pregnancy, which had been before well marked, would justify the opinion that an abortion had occurred; but it might denote nothing more than the death of the embryo, which can be retained within the uterus for varying periods of time, and when cast off may give rise to unjust suspicions as to the woman's moral character. Thus, if a woman whose husband has been absent many months should expel from her uterus an embryo corresponding perhaps to the second month of intra-uterine life, it by no means invariably follows that she has been unfaithful

Finally, if in the early months of pregnancy there is hemorrhage and a discharge of deciduous membrane, it is always wise

while making the digital examination, to feel on either side of the uterus for a tumor that might indicate a tubal pregnancy, and to inquire for the characteristic pain of that condition. A large proportion of the cases of extra-uterine pregnancy in the author's case-books were mistaken by their medical attendants for an incomplete abortion.

Prognosis of Abortion and Miscarriage.—The destruction of the embryo is inevitable. Statistics have been given showing that every abortion or miscarriage entails a risk upon the woman. The hemorrhage, if rarely so great as to be immediately fatal, may, by its persistence, so weaken a woman that she quickly succumbs if attacked by an intercurrent affection, or the syncope produced by loss of blood may favor the formation of heart-clot. The retention of masses of decidua or of placenta is often followed by their decomposition, by chronic salpingo-oöphoritis, or even by fatal septicemia. Tetanus is another complication which, in rare cases, helps to raise the mortality.[1] Criminal abortions, with the additional risk of traumatism from the unskilful use of instruments, and the probability of infection from unclean hands and implements, would probably show a very high rate of mortality if it were possible to collect accurate statistics. The prognosis of abortion depends in great part upon the treatment. If every case could be treated by an aseptic and skilful curettage, the mortality of abortion would be *nil.*

Treatment.—If a pregnant woman presents any of the conditions which a physician's experience or knowledge teaches him may lead to the premature interruption of pregnancy, the treatment of these conditions constitutes the preventive treatment of abortion. Much has been said upon this subject when the diseases of the embryo and fetus and of the ovum were under consideration. The proper conduct to pursue in the other complications of pregnancy just described may be briefly indicated.

In cases of irritable uterus the woman must be jealously guarded against any nervous shock, undue physical exertion, errors in diet, sexual intercourse—anything, in a word, that would furnish the uterus an excuse for throwing off its contents. In exaggerated cases of this condition prolonged rest in bed, especially at the time corresponding to the menstrual periods, or perhaps for the whole duration of pregnancy, may be neces-

[1] For twenty-one cases of tetanus after abortion see Bennington, "British Gyn. Jour.," 1885.

sary to secure the birth of a mature infant. If the pregnant uterus is displaced downward or backward, it must be restored to its proper position, and be kept in place by a suitable pessary or by tampons until its increasing size prevents its displacement again. Uncontrollable vomiting or coughing must be treated appropriately. Asthma, which in some cases determines a premature interruption of pregnancy, is best treated by change of climate.[1] In general muscular spasms, as in eclampsia, cholemia, chorea, epilepsy, hysteria, and tetany, the convulsions must be combated by appropriate remedies. The infectious and febrile diseases of pregnancy must be managed on general principles, without special regard to the danger of abortion, which is often unavoidable. Chronic metritis and endometritis, fibromyoma of the uterus, lacerated cervix, perimetritis and cellulitis, disease of a tube or an ovary, and appendicitis, must be treated before impregnation. If, in spite of every precaution, the signs of threatened abortion manifest themselves, the treatment resolves itself into: (1) The treatment of threatened abortion; (2) the treatment, if necessary, of inevitable abortion; and (3) the after-treatment.

The Treatment of Threatened Abortion.—The two main principles of the treatment to avert a threatened abortion should be perfect rest and the administration of drugs that diminish nervous sensibility and weaken muscular action. The first can only be secured in bed in a perfectly supine position. The room should be darkened and kept quiet, that the rest may be mental as well as physical. The second object of the treatment is accomplished by giving opium, bromid of potassium, and chloral. Opium enjoys a well-deserved reputation in these cases. It may be administered by the mouth as laudanum, hypodermatically as morphin, or, best, by the rectum as extract of opium in suppositories. Women on the verge of abortion usually display a remarkable tolerance of opium, and to be effective the dose must often be large. As much as a dram (3.9 gm.) or more of laudanum has been given within twenty-four hours without ill effect, but, of course, the patient must in such cases be carefully observed. With the opium it is often an advantage to combine moderate doses of chloral and bromid of potassium. Viburnum prunifolium[2] has been much vaunted as almost a specific in the prevention of abortion, and its use has become general throughout America. The verdict is favorable.

[1] See note by Harris to Playfair's "Midwifery," p. 243.

[2] Jenks, "Viburnum Prunifolium," "Trans. Amer. Gyn. Society," vol. i, p. 130.

It may be given in the form of a fluid extract, in teaspoonful doses three times a day. My routine medicinal treatment is a suppository of a grain (0.065 gm.) of the extract of opium morning and evening, and a dram (3.75 c.c.) of the fluid extract of viburnum three times a day.[1]

Treatment of Inevitable Abortion.—As soon as all hope of arresting the abortion is destroyed by the appearance of signs pointing to the unavoidable expulsion of the uterine contents, the treatment must be radically altered. Absolute rest is no longer necessary, while the administration of drugs that diminish sensibility and weaken muscular action is positively harmful, for it prolongs a process which in the interests of the patient is best completed as speedily as possible. But days often elapse before the greater part of the uterine contents is expelled, and it may be weeks before she is rid of the thickened decidua, which usually remains behind, or of the adherent placenta, which is often retained in the uterus after the escape of the embryo and the remainder of the ovum; and all this time there may be recurring hemorrhages of an alarming character or a constant dribbling of blood. The lochial discharge is profuse, brown in color, and probably foul-smelling. In such a case the evacuation of the uterus must be considered.

If the hemorrhage is profuse before the os is at all dilated or any portion of the ovum is discharged, there is no difference of opinion as to the necessity of controlling the bleeding. This is best effected by a vaginal tampon of sterile or iodoform gauze. A Sims speculum facilitates its introduction.

The tampon should be removed after twelve or twenty-four hours, and replaced by a fresh one if necessary; often as the first tampon is removed, the ovum or fetus comes with it and the immediate symptoms may in great part subside. But the uterus may not yet be empty; in the early months the large mass of decidua is almost entirely retained; later, the placenta is frequently retained. Whether to treat the case expectantly until serious symptoms develop, or to remove at once the substances in the uterus which may give rise to future complications, is a problem that must frequently confront every practitioner. In the hands of a general practitioner without special knowledge of gynecological technic, the best results are probably secured by the expectant treatment, so long as there is no fever, no excessive hemorrhage, or no odor of putrefaction. In the hands of a trained gynecologist the best and safest treatment of an abortion

1 Negri has recommended large doses of asafetida if there had previously been a tendency to abort or to give birth to dead children.

is an aseptic evacuation of the uterus by a placental forceps, the finger, or a curet.

Expectant Treatment.—When an abortion becomes inevitable, ergot may be substituted for the drugs that have been employed to inhibit muscular action, but it should be remembered that the prolonged use of ergot in full doses complicates the case if later it is found necessary to evacuate the uterus, and the drug itself may cause retention of the ovum by constricting the cervix. If there is much bleeding, tampons are to be used in the manner already indicated, and renewed every twelve hours until the ovum is expelled, or else so well separated from the uterine wall that it may be gently expressed or easily extracted by the fingers. The greatest care must be exercised to avoid rupture of the membranes, which will probably lead to the retention of a portion of the ovum, whereas its expulsion as a whole is particularly desirable in cases managed expectantly. If a part of the embryo or its appendages remain behind in the uterus, the woman is kept quiet in bed and small doses of ergot are administered. The vagina and, if possible, the uterine cavity are kept clean by douches of sterile water. If the discharge becomes foul, the temperature rises, or hemorrhage occurs, the uterine cavity must be evacuated. The technic is described later.

Active Treatment.—The tampon is used to control bleeding. When the dilatation of the os is sufficient to admit a finger, efforts are made, in early abortions, to turn out the ovum by sweeping the finger around it, and then extracting it with the finger hooked behind it; or Hoennig's method of expression may be tried.[1] These methods are most successful when the ovum is lodged in the cervical canal and lower uterine segment, its escape being prevented by an undilated external os. The hemorrhage is usually profuse. The ovum being wholly or in part expelled, everything left behind in the uterine cavity, whether thickened decidua or placental tissue, must be extracted. For an adherent placenta nothing is better than the finger, which can be made to reach the fundus by pressing the uterus down from above through the abdominal walls, the patient being anesthetized if necessary. The placenta is peeled off from the uterine wall, and afterward easily extracted. So much force is often necessary to do this that the use of an unyielding and insensible instrument is not advisable. To clear out the thickened decidua, which almost invariably remains behind in early abortions, nothing is so good as a broad dull curet. Dührssen has

[1] The uterus is squeezed between the fingers in a combined examination, and the uterine contents are pressed out as a stone is expressed from a cherry.

demonstrated that the decidua removed from the uterus in this manner is not roughly torn off, but is separated in a natural manner in the cellular layer. An indispensable adjuvant to the curet is Emmet's curetment forceps, used as a placental forceps, to extract fragments of decidua loosened by the curet. If the os is so retracted that neither a finger nor an instrument can be inserted, the introduction of Hegar's graduated cervical bougies the use of branched dilators or of a metranoicter for twelve hours obviates the difficulty.

After the uterine cavity is evacuated, it should be irrigated.[1]

The After-treatment of Abortion.—If active treatment has been pursued, the after-treatment is simple, for the lochial discharge is slight and the involution of the uterus rapid. Until involution is perfected the woman should be confined to bed. It is never safe, even in the earliest cases, to allow her to get up in less than a week or ten days. The after-treatment when an expectant plan has been pursued has already been indicated. Should septicemia develop, it is treated as after delivery at term.

Missed Abortion.—By this term is meant the death of the embryo, threatened abortion, the subsidence of symptoms, and the retention of the ovum for a varying length of time.[2] Missed abortion may give rise to undeserved suspicions of a woman's virtue or to ludicrous mistakes in diagnosis. I was called in consultation to see a young woman who discharged at term an ovum about the size of a lemon retained *in utero* some seven months after the death of the embryo. The young wife and her husband were wealthy and heartily welcomed the prospect of a child. They had provided an elaborate and expensive outfit for the baby, including a coach. At the end of nine months from the date of the last normal menstruation, labor-pains appeared. The family physician made repeated examinations and assured the husband and wife that the progress was satisfactory. At length, after twenty-four hours of hard pains, a little two-month ovum was expelled, to the inexpressible astonishment of the parents and the chagrin of the doctor.

Miscarriage.—Much that has been said of abortion is applicable to miscarriage as well; but by the time pregnancy has reached a period from the fourth to the seventh month it is not

[1] I have tried every model of a two-way uterine catheter on the market and find Fritsch's modification of Bozeman's the best.

[2] The fetus has been retained *in utero* five, eleven, and even fifty-one years—L. C. Peter, "Amer. Gyn. and Obstet. Jour.," Feb., 1899.

likely that the condition will be overlooked, so that one great difficulty in the diagnosis of abortion, the doubt as to the existence of pregnancy, does not, as a rule, obtain in cases of miscarriage. In these cases, too, it is easier to detect the two accidents which make the expulsion of the ovum almost inevitable—rupture of the membranes and the death of the fetus; for the liquor amnii has reached such a quantity that its escape would almost always attract attention, while the death of the fetus, followed by a cessation of fetal movements and of growth in the uterus, by a disappearance of the reflex and psychical disturbances characteristic of pregnancy, and also, perhaps, by the appearance of the milk-secretion, is not likely to pass unnoticed. The pain associated with miscarriage is greater than in abortion, and assumes the type of labor-pains. During the periodic contractions of the uterus the organ can be felt through the abdominal walls, becoming hard and firm and relaxing again as the pain passes off. The expulsion of the ovum resembles also a labor at term, as the fetus usually is first expelled and the membranes and placenta follow after. As pregnancy advances this sequence becomes more and more the rule, but occasionally the ovum is cast off entire, even at a late period of pregnancy. I have seen such an occurrence at the seventh month, and it has actually been reported to have occurred at term.

Miscarriage is chiefly distinguished from abortion by the formation of the placenta, and from premature labor by the adhesion of the placenta to the uterine wall, its retention, and consequent serious hemorrhage or infection.

EXTRA-UTERINE PREGNANCY.

By extra-uterine or ectopic pregnancy is meant the development of an impregnated ovum outside of the uterine cavity. The condition was described by Riolanus, Benedict Vassal (1669), and by Regnier de Graaf. Abdominal sections for extra-uterine pregnancies were performed by Nufer (1500) and by Dirlewang (1549). Böhmer (1752) differentiated the tubal, ovarian, and abdominal forms of ectopic gestation. Schmidt (1801) described interstitial pregnancy.

Frequency.—The exact proportion of extra-uterine to intra-uterine gestations is difficult to determine. It has been said to be about 1 in 500 normal pregnancies. Winckel, however, saw but 16 cases in 22,000 births, and Bandl, in Vienna but 3 out of 60,000. An experienced specialist in the larger cities of America usually sees from three to fifteen cases annually.

Classification Based upon the Situation of the Developing Ovum.

TUBAL.

Tubo-uterine, or interstitial. The ovum develops in that portion of the tube which runs through the uterine wall.

Tubal proper.

Tubo-ovarian. The ovum is attached to the ovarian fimbria.

OVARIAN. The ovum develops in a Graafian follicle.

ABDOMINAL. In primary abdominal pregnancy the ovum imbeds itself in the peritoneum.

Secondary abdominal.

Ovario-abdominal. The ovum, beginning its growth in the ovary, pushes its way out into the abdominal cavity.

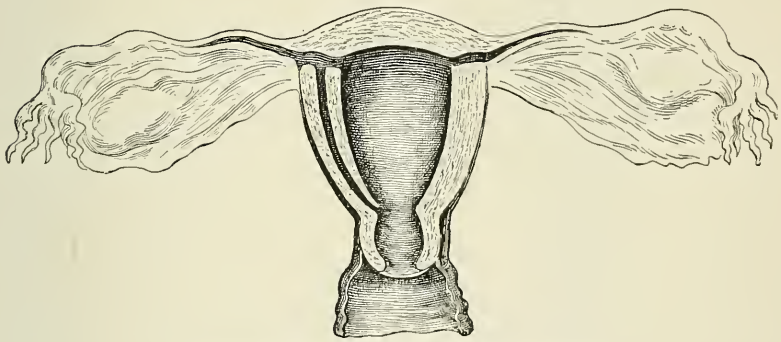


Fig. 185.—Bifurcation of tubal canal (Hennig).

Tubo-abdominal. The ovum, at first contained in the tube, escapes into the abdominal cavity by rupture or by a gradual separation of the fibers in the tubal coat. There is a form of tubal pregnancy often called secondary abdominal or tubo-abdominal, in which the ovum grows downward and backward behind the peritoneum. This should be known as a broad-ligament or retroperitoneal pregnancy.

Utero-abdominal. The ovum grows at first in the uterine cavity, but, in consequence of a spontaneous rupture or separation of an old scar in the uterine wall, becomes an abdominal pregnancy, retaining its connection with the uterus by the placenta.

Etiology.—The causes of ectopic gestation are conditions

delaying the progress of the ovum from the ovary to the uterus until a stage of development is reached at which the ovum imbeds itself in maternal tissues. Any disease of the mucous membrane of the tube depriving its cells of their cilia, forming mucous polypi or otherwise obstructing its caliber, predisposes to an arrest of the impregnated ovum in its passage to the womb. So does any condition interfering with the normal peristalsis of the tube. Chronic salpingitis, therefore, is often found associated with and preceding tubal pregnancy.

Peritoneal adhesions from a precedent salpingitis [1] or appendicitis constricting or distorting the tubes and congenital or acquired stenosis may also obstruct the tubal canals. A diverticulum in the tube, an accessory tubal canal, accessory abdominal ostia, and atresia of the tube have been noted in connection with ectopic gestation. An exaggeration of the characteristic serpentine course of the tube may make the progress of the ovum difficult and may arrest it before it can reach the uterus. Fibromyomata of the uterus and tumors of the broad ligament have caused tubal obstruction. Anything which increases the size of the ovum before it has emerged from the tube may be a cause of extrauterine pregnancy; thus, external transmigration, twins, or an unusually long tube may result in such a development of the ovum before its arrival in the uterine cavity that it imbeds itself in the tube.

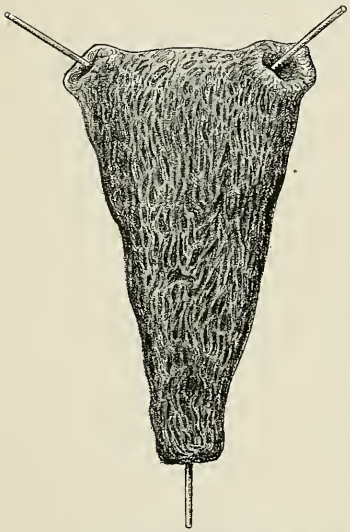


Fig. 186.—Decidual cast of the uterine cavity in extra-uterine pregnancy (Zweifel).

Clinical History.—In each of the situations noted above the course of gestation may be somewhat different, and each may present an individual clinical picture on account of the difference in the surrounding anatomical structures which are involved. The general presumptive signs of pregnancy are commonly the same as in intra-uterine gestation, but there is usually severe pain.

[1] The majority of my cases have had a history of previous salpingitis, and I have treated several of them for gonorrhea months and years before the tubal gestation occurred. In one case I found a four weeks' ovum and embryo in the middle of a gonorrheal pus tube that had been under observation for a year. The operation was performed for what was supposed to be an exacerbation of the salpingitis.

Extra-uterine pregnancy occurs oftenest between the twentieth and thirtieth years. The youngest woman affected was fourteen, the oldest forty-seven years of age.

Changes in Uterus and Vagina.—In all the forms these changes are alike. Most of the alterations characteristic of intra-uterine pregnancy are found: hypertrophy of the vaginal mucous membrane, with increased blood-supply (purple tinge) and increased secretion; a soft cervix and a patulous os; an enlarged uterus, and, in the majority of cases, a development of a deciduous membrane, undergoing the same change as in intra-uterine gestation preparatory to its separation and extrusion, which occurs in extra-uterine gestation usually between the eighth and twelfth week, the membrane being expelled as a complete cast of the uterus and even of the tubes, or in shreds. The usual clinical history of ectopic gestation is absence of menstruation until the death of the embryo or rupture of the sac, when the menses return with the discharge of the decidua. The metrorrhagia which thus begins may continue for a long time.

The other changes in the maternal organism may vary with the situation of the developing ovum.

Clinical History and Pathology of Tubal Pregnancy.—Usually the woman has had children, but a long time has elapsed since the birth of the last child. The most frequent situation of an extra-uterine gestation is the outer third of the tube (the ampulla [1]). In this position it may grow upward into the abdominal cavity, distending the tube-walls to the point of rupture, or it may grow downward between the layers of the broad ligament, and then backward and upward behind the posterior parietal layer of the peritoneum (broad-ligament gestation). The tubal walls show irregular hypertrophy from the development of their muscle-fibers. The point of rupture is at the site of original attachment of the ovum, the cells of the chorion villi burrowing into the tubal wall and weakening it. Fever is often seen, sometimes to a high degree, even before rupture. The usual temperature, however, before rupture is between 99° and 100° F. After rupture there may be a low temperature indicative of hemorrhage. Reaction may quickly occur, and fever is not incompatible with profuse intraperitoneal hemorrhage. There is a moderate leukocytosis, usually about 12,000. Exceptionally, the tubal gestation may proceed to full term. In these cases the ovule has probably at first grown downward and backward. If perforation of the tubal wall occurs, it usually takes place between the eighth and twelfth weeks, but it may occur as early as

[1] Martin's statistics of 55 cases of extra-uterine pregnancy give this situation in 49.

the fourteenth day,[1] or not till after the sixth month. If the tube ruptures upon the upper or posterior aspect of the sac, the sac-contents are extruded into the peritoneal cavity with an intra-peritoneal hemorrhage. If rupture occurs on the lower aspect, the contents of the ovum and the blood find their way between the layers of the broad ligament and the pelvic fascia, giving rise to an extraperitoneal hematocele. The first variety is usually fatal; the last is not always directly dangerous to life, but the layers of the broad ligament may rupture when distended with blood, and the bleeding then becomes intraperitoneal and unlimited. The bleeding may also be limited by peritoneal adhesions shut-

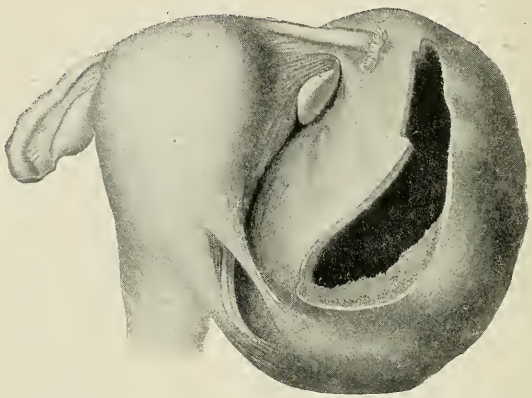


Fig. 187.—Broad ligament pregnancy (Zweifel).

ting off the peritoneal cavity and forming a closed sac in the iliac region. From adhesions to intestines, complications, such as perforation and obstruction of the bowel, may occur.

Recent studies of the behavior of the ovum in relation with the tubal wall and the mucous membrane explain the difference of opinion once prevalent as to decidua formation and also explain the clinical course of tubal gestation. The ovum may imbed itself either in plications of the tubal mucous membrane or directly in the muscular tubal wall. In the former case the bed of the ovum is in the connective tissue of a stem of the mucous membrane folds. The maternal tissues, including blood-vessels, are eroded by the cells of the trophoblast; the thin capsule of the ovum is penetrated and, hemorrhage occurring into the lumen of the tube,

[1] Ross, "Am. Jour. Obstet.," October, 1895. According to Hecker's statistics of 45 cases, rupture occurred 26 times in the first two months, 11 times in the third, 7 in the fourth, and once in the fifth. In two of my cases rupture occurred no later than the fourteenth day.

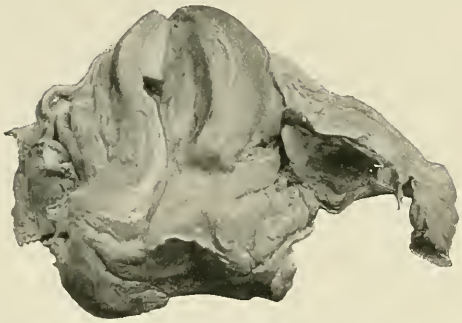


Fig. 188.—A ruptured broad ligament pregnancy.

Fig. 189.—Ruptured broad ligament pregnancy.

Fig. 190.—Ruptured broad ligament pregnancy. The embryo *in situ*.

escapes from the fimbriated extremity into the peritoneal cavity (tubal abortion). In the latter case the trophoblast makes a nest for the ovum in the tubal wall, burrowing into the muscle at the base of the plications of the mucous membrane or in the isthmus where these plications are not developed. At the point where the ovum attaches itself the cells of the villi penetrate toward the periphery of the tube, opening the walls of blood-vessels and penetrating the tubal wall to the serous covering, which eventually gives way. Thus the so-called rupture of tubal pregnancies occurs, with intraperitoneal hemorrhage.

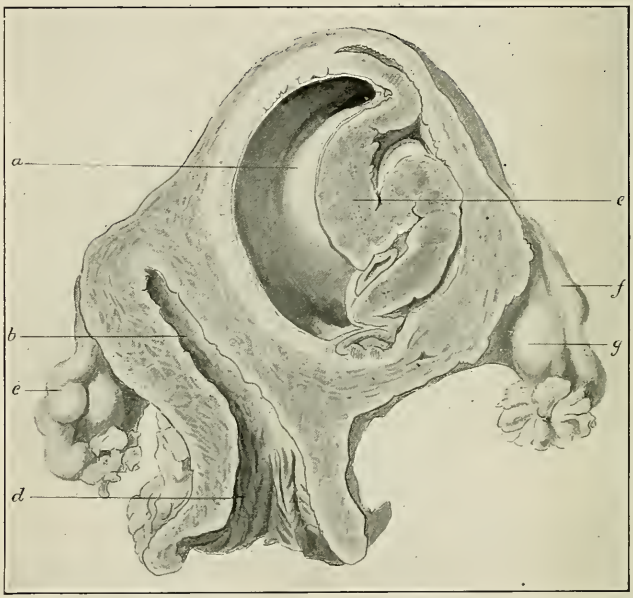


Fig. 191.—Interstitial pregnancy, fourth month; vaginal hysterectomy. *a*, Cavity of the ovum; *b*, uterine cavity; *c*, left tube; *d*, cervix; *e*, partially detached placenta; *f*, right tube; *g*, right ovary (Bumm).

There can be no true decidual formation in the nest which the ovum makes for itself in muscular tissue, beneath the tubal mucous membrane, for the cells of the intermuscular connective tissue do not undergo this metaplasia, but in other portions of the tubal mucous membrane distant from the ovum, even in the other tube, there is an irregular development in limited areas of decidual cells. The cells in the bed of the ovum, often described as decidual cells, are really derived from the trophoblast (Langhans' cells). There may be a reflexa formation, irregularly and feebly

developed as the ovum grows and projects into the lumen of the tube, but there is often an underlying layer of muscular tissue and the capsule of the ovum soon degenerates and is penetrated by the trophoblast, so that the villi of the latter contract attachments with the plications of the tubal mucous membrane or, in the isthmus, with the opposite tubal wall.

There may be multiple (twin and triplet[1]) extra-uterine gestation; coincident intra- and extra-uterine pregnancy; pregnancy first in one tube and then in the other; simultaneous pregnancies in both tubes[2]; or two successive pregnancies in the same tube.[3] Hydramnios was noted in one case of tubal pregnancy[4] and a thoracopagus was found in another.[5] Several cases of hydatidiform mole and also cases of chorio-epithelioma have been observed in tubal pregnancies.[6]

Clinical History of Interstitial Pregnancy.—The ovum develops in the uterine wall, the inner side of the sac often projecting into the uterine cavity, and having on its outer side the round ligament and the whole length of the tube. The usual termination is rupture into the peritoneal cavity. Hecker collected twenty-six cases, all ending in rupture before the sixth month. Rupture into the uterine cavity and expulsion of the fetus through the cervix are possible. Rupture into or growth between the layers of the broad ligament is also possible.[7]

Clinical History of Tubo-ovarian Pregnancy.—The ovum develops between the fimbriæ of the tube and the ovary. The sac may rupture with the usual consequences of such accident. It is possible, however, to see a development of the fetus to maturity. The ovum may lodge upon the ovarian fimbria and may thence grow inward between the layers of the broad ligament.

[1] Sänger, "Centralbl. f. Gyn.," No. 7, 1893. Krusen, "Tr. Phila. Co. Med. Soc.," October, 1901. v. Neugebauer, "Zur Lehre von der Zwilling Schwangerschaft mit heterogenem Sitz der Früchte," Leipzic, 1907.

[2] Martin has collected 8 cases, "Zeitschr. f. Geburtsh. u. Gyn.," Bd. xxxviii, H. 1. Jayle, 28 cases. "Rev. de Gyn. et de Chir. Abdom.," No. 2, 1904.

[3] Coe, "N. Y. Med. Record," May 27, 1893; Dorland, "Repeated Extra-uterine Pregnancy," "Amer. Jour. Obstetrics," April, 1898; Royster, "Combined Intra- and Extra-uterine Pregnancy at Term," *ibid.*, 1897, vol. xxxvi, p. 820; Mosely, *ibid.*, 1896, thirty-eight cases of intra- and extra-uterine pregnancy. Zinke, *ibid.*, xlv, No. 5, 1902, 88 cases. Neugebauer, 129 cases. Heinricius and Kolster report two fully developed fetuses in one tube, one macerated, the other well preserved, "Archiv f. Gyn.," Bd. lviii. Pestalozza has collected 108 cases of repeated tubal pregnancies: "Arch. Ital. di Gin.," No. 5, p. 474, 1900. Naples.

[4] "Archiv f. Gyn.," Bd. xxii, S. 57.

[5] "Centralbl. f. Gyn.," 1894, p. 232.

[6] Werth, "Winckel's Handbuch," 2^2, p. 822.

[7] Werth gives forty as the number of interstitial pregnancies in the literature which bear criticism. "Winckel's Handbuch," 2^2, p. 739.

Clinical History of Ovarian Pregnancy.—The ovum, impregnated while it is still within the Graafian follicle, reaches some degree of growth and development within the ovary. The tube and ovarian fimbria are free, the uterus is connected by the ovarian ligament with the gestation sac, the wall of which consists in great part at least of ovarian tissue. The condition is exceedingly rare, but there are a few indubitable cases on record.[1] A case reported by Baer went to term. Müller and Widerstein have reported cases of the prolapse of a pregnant ovary into the inguinal ring and canal.

Clinical History of Abdominal Pregnancy.—Primary abdominal pregnancy is exceedingly rare. Many gynecologists deny its occurrence, but there have been a few authentic cases.[2] The conditions in the free abdominal cavity favor the progress of pregnancy to the mature development of fetus. The peritoneum is converted into decidua-like membrane wherever the ovum comes in contact with it, and from this source the chorion and placenta derive nutriment. The ovum is surrounded by a fibrous and vascular capsule. In abdominal and in advanced tubal gestation abortive labor-pains appear at term. The child dies at or shortly after this period, and the liquor amnii is absorbed after the death of the fetus. The abdomen is consequently reduced in size and the tumor is changed in consistency. The fetus may be converted into a lithopedion and may remain as an innocuous tumor in the abdomen for years (see Termination of Extra-uterine Pregnancy, and Changes in Fetal Body after Death). The child is likely to be small and ill-formed, but occasionally overgrown children are reported, if fetal life is prolonged beyond the usual duration of pregnancy. In advanced cases of abdominal pregnancy the fetal movements are exceedingly painful to the

[1] Cases are reported by Potenko, Werth, Paltauf, Leopold, and Martin. See Winckel, "Geburtshülfe"; Kelly, article in "American Text-book of Obstetrics." Ludwig, "Wien. klin. Woch.," 1896, has collected 18 cases besides one of his own. Leopold claims that there are thirteen authentic cases recorded, "Archiv f. Gyn.," Bd. lix. Catharine von Tussenbroek demonstrated a specimen removed by Kouwer, of Harlem, "Tr. III Congress of Gyn. and Obst.," Amsterdam, 1899. Micholitsch found two cases among 120 cases of extra-uterine pregnancy operated on in Wertheim's Clinic ("Zeitschr. f. Geb. u. Gyn.," Bd. xlix, H. 3). C. C. Norris, "Tr. Philada. Obstet. Soc.," 1908; Bryce, Teacher and Kerr, "Early Ovarian Pregnancy," Glasgow, 1908.

[2] Schlechtendahl has reported a case of primary abdominal pregnancy in which a fetus fifteen centimeters long was found incapsulated near the spleen. The tubes and uterus were normal ("Frauenarzt," 1887, ii, pp. 81–86). Braun's and Zweifel's cases ("Archiv f. Gyn.," Bd. xli, H. 1 and 2), in which the placenta was attached to the posterior uterine wall and to the sigmoid flexure, and Köberle's case, in which impregnation occurred through a vagino-abdominal fistula after hysterectomy, were probably primary abdominal pregnancies. Three cases may be accepted as beyond criticism: Galabin's, Witthauer's, and the author's. (Hirst and Knipe, "Surgery, Gyn. and Obstet.," October, 1908.)

mother. Abdominal pregnancies may end in rupture of the sac or there may be profuse hemorrhage into the sac-cavity.

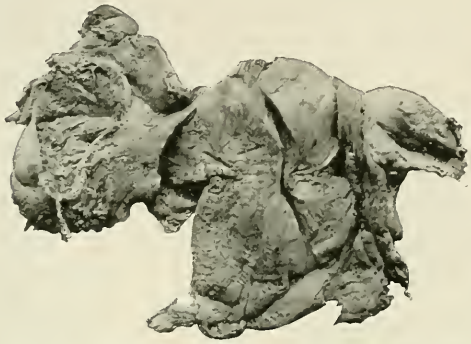


Fig. 192.—Tubo-ovarian pregnancy. Sac ruptured.

Fig. 193.—The ovum imbedded under the peritoneum of the broad ligament.

Clinical History and Pathology of Utero-abdominal Pregnancy.—This condition is very rare. The pregnancy is at first intra-uterine, but the ovum escapes into the abdominal cavity through an opening in the uterine wall, retaining a connection by the placenta with the uterine cavity. The process of extrusion must be gradual. These cases follow either a Cesarean

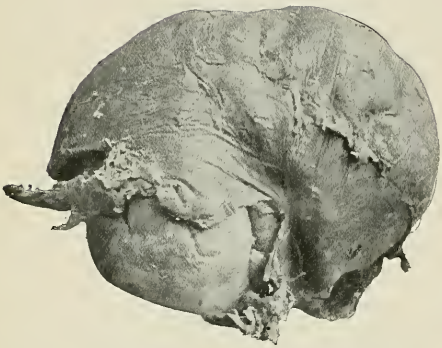


Fig. 194.—Reported as an ovarian pregnancy.

Fig. 195.—Reported as an ovarian pregnancy.

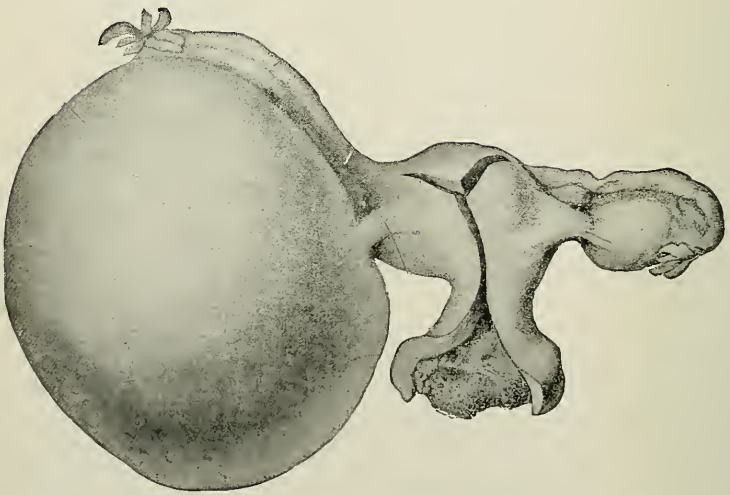


Fig. 196.—August Martin's case of ovarian pregnancy. The intact tube is seen lying above the ovarian sac containing the fetal envelopes. The ovarian ligament runs from the sac to the uterine cornu.

section or a rupture of the uterus at a previous labor. The fetus may grow to full term.[1]

Terminations of Extra-uterine Pregnancy.—*Death and Absorption of the Young Embryo with Absorption of the Liquor Amnii, and Atrophy of the Gestation Cyst.*—Of all the terminations of ectopic gestation, this is the most favorable. It is exceptional, and should never be counted on in practice. The embryo must die before the second month to be completely absorbed. At the best, chronic salpingitis with adhesions persists, and the woman may, therefore, be left a chronic invalid.

Rupture of the sac and profuse hemorrhage occur most commonly in tubal gestation, when the growth is upward toward the abdominal cavity. At least two-thirds of all ectopic gestations end in rupture of the sac or in tubal abortion. Rupture may

Fig. 197.—Ruptured tubal pregnancy; sac involving the isthmus.[2]

occur when the ovule grows downward between the layers of the broad ligament; also in tubo-uterine, tubo-ovarian, ovarian, and abdominal pregnancies. The accident commonly destroys the embryo, which may escape into the abdominal cavity. Up to the second month the extruded embryo may be absorbed. Later, it may be found lodged among the intestines, perhaps far removed from the pelvic organs and usually surrounded by clotted blood.[3]

[1] "Ausgetragene secundäre Abdominalschwangerschaft nach Ruptura uteri, im vierten Monat," Leopold, "Archiv f. Gyn.," lii, 2, 376. Fullerton, "Annals of Gyn.," October, 1891.

[2] Figs. 188 to 190 and 197 to 206 inclusive, also figs. 192 to 195, are from photographs presented to me by the late Dr. Formad, for some time coroner's physician of Philadelphia. He obtained the specimens in his official capacity, while investigating the cause of sudden deaths.

[3] Burford reports an extraordinary case in which the tube ruptured, the fetus was extruded through the rent, the cord was torn across, and the fetus with the cord attached was found in the abdominal cavity inclosed in an adventitious sac. The placenta remained in the tube and the rent in the latter, through which the fetus escaped, had healed. "Brit. Gyn. Jour.," 1892.

Rupture of the tubal wall has been reported without hemorrhage, the head of the embryo fitting into the gap and acting as a tampon. The hemorrhage may be fatal in as short a time as two hours; it usually takes from eight to sixteen hours, however, for the woman to bleed to death. The hemorrhage may be fatal as late as the second, third, or fourth day, or there may be successive hemorrhages, perhaps days apart, until the patient is gradually exhausted or is suddenly destroyed by an unusually profuse outpour of blood. Surprisingly small tubal gestation sacs may, on rupture, give rise to fatal hemorrhage. In such cases the ovum is usually imbedded in the tube near the cornu of the uterus. The determining cause of rupture is not always apparent. It may occur while the patient is lying quietly in bed, but may follow the straining of defecation or urination, coitus, a blow upon the abdomen, a gynecological examination, an operation like curetment, or any sudden physical effort or mental excitement. The trophoblast having eroded the tubal wall to and even through the peritoneum, it requires little or no extra strain to establish a com-

Fig. 198.—Ruptured tubal pregnancy; sac involving the whole length of the tube.

munication between the bed of the ovum, with its opened blood-vessels, and the peritoneal cavity. Rupture of the sac or of a blood-vessel in its wall, with profuse hemorrhage, has occurred long after the destruction of the embryo and cessation of growth in the sac (two years in one case).

Rupture of sac with extrusion of its contents, and interstitial hemorrhage into the sac-walls, without escape of blood into peritoneal cavity or between the layers of broad ligament, was the termination of one case of tubal gestation under my observation.

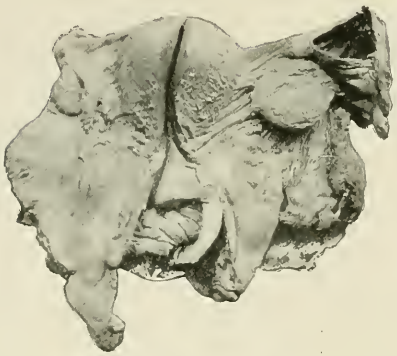


Fig. 199.—Ruptured tubal pregnancy; sac involving the ampulla.

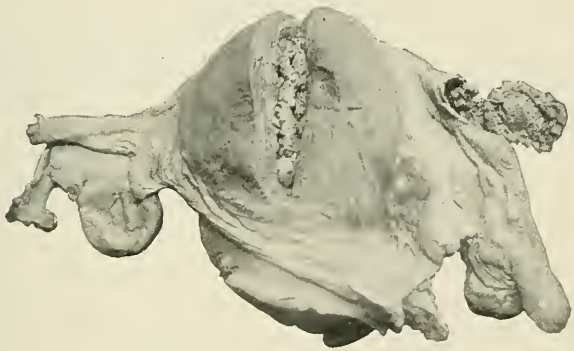


Fig. 200.—Ruptured tubal pregnancy; sac situated wholly in the isthmus. The size of the sac is very small to occasion, on rupture, a fatal hemorrhage; its situation, however, near the uterus, is a very dangerous one. The decidua lining the uterine cavity is plainly seen.

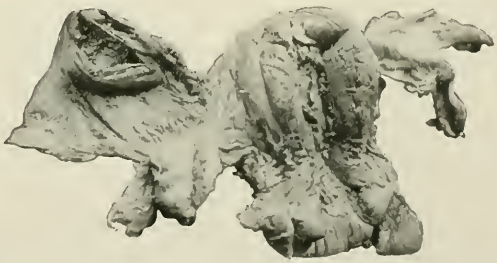


Fig. 201.—Ruptured tubal pregnancy; sac occupying the middle third of the tube.

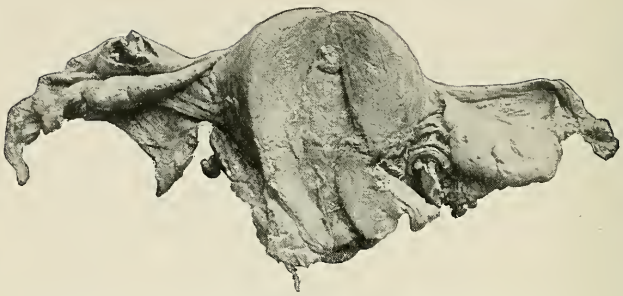


Fig. 202.—A very small gestation sac in middle third of tube. Rupture; death.

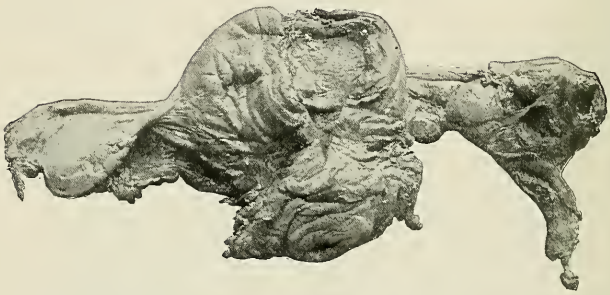


Fig. 203.—Ruptured tubal pregnancy; the sac occupying the ampulla and fimbriated extremity of the tube.

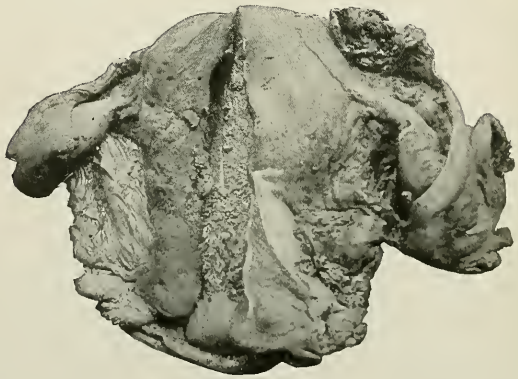


Fig. 204.—Ruptured tubal pregnancy; the sac situated at the uterine insertion of the tube.

This occurrence might be followed by atrophy of the ovum and sac.

Tubal moles are frequently seen as the result of an old tubal pregnancy; the ovum is infiltrated and surrounded by blood, clotted and often organized. The tubal walls are also infiltrated with blood and are much thickened. The whole mass constitutes a solid tumor of the tube in which the embryo may not be found, and atrophied chorion villi in small numbers are only discovered after a careful microscopic search.

Growth of the Fetus after Third Month; Its Death at or before Maturity and the Changes that Occur Afterward.—A continued development of the fetus in the later months of pregnancy is seen most often in abdominal or in tubo-ovarian pregnancies, though it is possible in the tubal gestation with retroperitoneal growth (broad-ligament pregnancy). The fetus after death may be converted into a lithopedion or may be mummified, and in these conditions may remain in the abdominal cavity indefinitely (in Sappey's case fifty-six years), or may be removed by operation through the abdomen, vaginal vault, or possibly by the rectum. The soft parts may macerate and may be absorbed, leaving the bones, which remain as an innocuous abdominal tumor or ulcerate into the bladder, intestines, or through the anterior abdominal wall. Ulceration into the bladder is a particularly unfortunate complication. I have seen an old lady die of peritonitis caused by the ulceration of a parietal bone through the transverse colon. Her history indicated an abdominal pregnancy many years before.

The fetal body may putrefy from the contiguity of the intestines and their contained micro-organisms and the consequent access of bacteria to the highly putrescible sac-contents. In the same way the gestation-sac is converted into an abscess.

Terminations of Ovarian Pregnancy.—There may be an arrest in the development of the ovum at an early period. In one case the small, cystic, ovarian tumor containing the fetal bones was retained in the abdomen for years. In another case the fetus went on to full development, then died, and was removed in a good state of preservation at least one year later. Rupture of the sac and profuse hemorrhage may occur.

In *tubo-uterine* or interstitial pregnancies the ovum and embryo may be discharged into the uterine cavity, and may be evacuated by the natural passages. There are at least two such cases well authenticated. Rupture of the sac and hemorrhage into the peritoneal cavity is, however, the rule. In Mascka's case the head of the fetus passed into the abdominal, the breech into the uterine, cavity.

In cases of *tubal abortion* (so named by Werth) there is an internal rupture of the tubal wall, of its connection with the ovum, or the epithelial cells of the chorion villi penetrate the wall of a vessel of some size, and blood is poured through the fimbriated extremity of the tube into the abdominal cavity. The

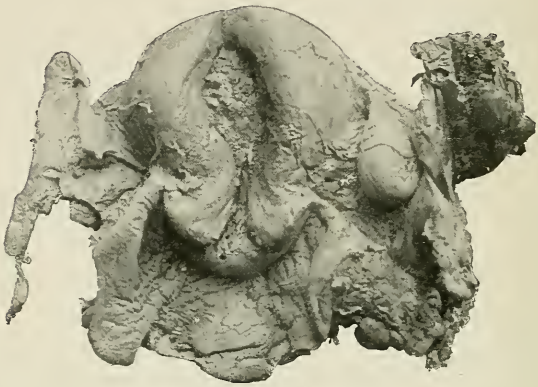


Fig. 205.—Tubal abortion.

Fig. 206.—Tubal abortion.

blood-clots filling the pelvis in such a case may have a peculiar sausage-like form imparted to them by the tubal canal. The whole ovum may possibly be extruded through the abdominal orifice of the tube, and in one case in which the fimbriated extremity was closed by inflammatory adhesions the outer end of the tube was converted into a hematoma. Tubal abortion is much more

frequent than rupture. In 75 cases the former occurred 59, the latter 16, times.[1]

It is possible that a tubal pregnancy may rupture in its early stages, the embryo be expelled into the abdominal cavity, retain-

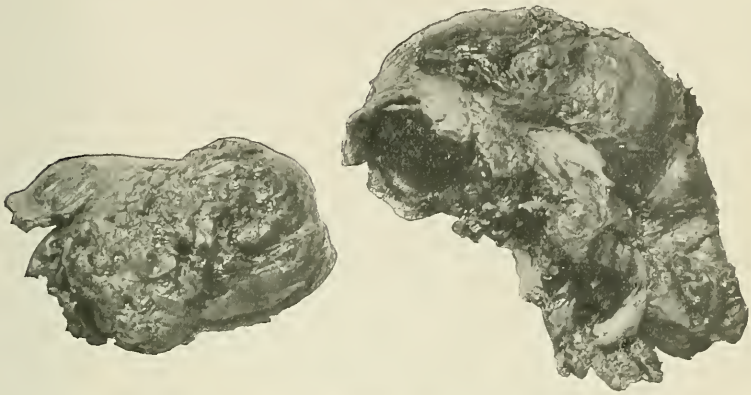


Fig. 207.—Tubal abortion and extruded mole.

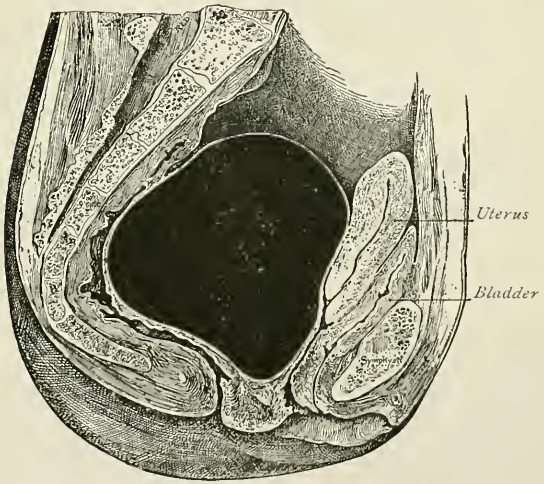


Fig. 208.—Diagram showing pelvic hematocele posterior to the uterus, which is crowded forward with the bladder behind the symphysis pubis, while the rectum is compressed behind against the sacrum (Skene).

ing its connection with the tube by the cord and placenta, and the fetus thus continue to further or to full development. This is called a *secondary* or *tubo-abdominal pregnancy*.[2] Rupture in

[1] "Volkmann's Samml. klin. Vorträge," N. F., Nos. 244, 245.

[2] Lusk has collected three such cases. The fetus survived the rupture of the tube, or the extrusion may have been gradual by a separation of the fibers in the tube wall.

cases apparently of this character may not have occurred. There may have been a retroperitoneal growth of the ovum and an enormous dilatation of the tubal walls.

Growth and development of the placenta after fetal death has been described, but has not yet been demonstrated beyond doubt. It would seem impossible, arguing from the behavior of the placenta *in utero* after fetal death.

Profuse hemorrhage into the gestation sac, forming a large hematoma, occurred in one case under my observation.

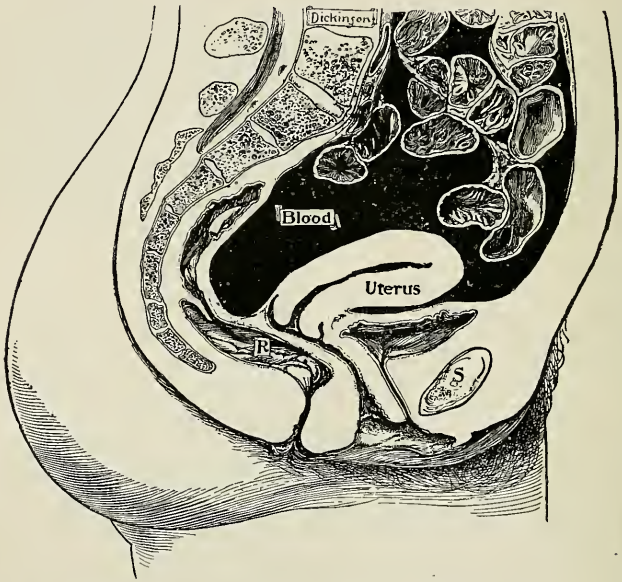


Fig. 209.—Diagram of intraperitoneal rupture of tubal pregnancy. Free blood in Douglas' cul-de-sac, and among the intestines: S, Symphysis; R, rectum (Dickinson).

Hematoceles and hematomata in the abdomen, pelvis, and pelvic connective tissue in one-third or more of the cases are due to the hemorrhage from a ruptured gestation sac. The blood may collect in front of the uterus (ante-uterine hematocele), more commonly behind the uterus (retro-uterine hematocele), may be encapsulated in the neighborhood of either broad ligament, or may be contained in the pelvic connective tissue on either side of the uterus. These accumulations of blood may suppurate, and may thus prove fatal. They may be evacuated by puncture through the abdomen or often through the vaginal vault. If not too large, they are absorbed.

Symptoms of Extra-uterine Gestation.—The Subjective Signs.—In the early weeks or months the subjective signs of ectopic pregnancy may be indistinguishable from those of normal intra-uterine gestation. In the tubal variety, which is by far the commonest, there may be no indication of any abnormality until rupture occurs or blood escapes into the peritoneal cavity from the fimbriated extremity of the tube. In the vast majority of cases, however, rupture or bleeding is preceded by severe cramp-like pains, usually in one or the other iliac region, often accompanied or followed by the discharge of deciduous membrane.

The pain of extra-uterine pregnancy is its most distinctive symptom. It is described by the patient in strongest terms; occurring in paroxysms, with intervals free from suffering; appearing at any time from a few days to months after a normal menstruation; situated often in one groin, though frequently indefinitely referred to the lower abdomen; extending down one leg or up to the epigastrium; and so severe as to occasion profound systemic disturbance—syncope, followed by nausea and vomiting, a cold sweat, hysterical outbreaks, complete disability, and every appearance of excessive shock. The temperature is almost always slightly elevated. The pulse is rapid and the blood-pressure low if there has been much hemorrhage. In one case extreme bradycardia was reported, probably due to some indirect stimulus of the vagus. There may be high fever and the general health may be much impaired. When advanced development occurs, as in abdominal and in some cases of tubal gestation, no symptoms may arise until the time for labor has passed, when pain and other complications, due to the peculiar character of the abdominal tumor, may appear. There is usually cessation of the menstruation for one or two periods; then a return of the flow as an irregular bleeding, which may last for months. In some cases irregular bleedings begin with conception and last until rupture—there is no cessation of menstruation. In others one period is slightly delayed; those after and before are normal. Again, the delayed period may be unnatural in character. In exceptional cases the menstruation occurs at the normal time, but is more profuse or scantier than normal. In 110 cases upon which I have operated there was no absence of menstruation in 18; a cessation of menstruation varying from 10 to 90 days in 92. There was metrorrhagia lasting from 2 to 120 days in 92 cases; there was a discharge of decidua in 50 cases.

Other symptoms noted have been irritable bladder or dysuria; marked constipation or even obstruction of the bowels if the tumor is on the left side; edema of the corresponding limb

and aching pain in it, especially at the groin; or numbness and loss of power. Pulsating vessels may be felt in the vaginal vault.[1]

Objective Signs.—In tubal pregnancies an exquisitely sensitive tumor may be felt to one side of, behind, or possibly in front of the uterus, quite firmly fixed after the third or fourth week, and doughy in consistence.[2] The uterus is much smaller than would be expected from the duration of the pregnancy. After the third month ballottement may possibly be practised upon the tubal tumor. The uterus is usually displaced forward, backward, or to the side opposite the tumor. The decidua is expelled from the uterus in a large proportion of cases (45 per cent. of my own). If the discharged membrane can be obtained, it will present, under the microscope, unmistakable characteristics of decidua. It may be extruded in fragments or as a complete cast of the uterus.

Symptoms of Interstitial Pregnancy.—A diagnosis is difficult or impossible. The uterus enlarges to a greater degree than in any other variety of ectopic gestation, and it may be impossible to determine whether or not it is symmetrically enlarged. The condition is recognized after an abdominal section or upon a careful intra-uterine exploration.

Abdominal pregnancy may be recognized when the ovum occupies Douglas' pouch, as the fetal parts may be made out with startling distinctness through the posterior vaginal vault. A sacculated uterus, however, might easily be mistaken for an abdominal pregnancy. There is unusual pain from fetal movements, and abdominal palpation may give unusually distinct results. It may be possible to outline the empty uterus.

Diagnosis.—A diagnosis of extra-uterine pregnancy can usually be made before rupture. In spite, however, of careful attention to the patient's history and a painstaking physical examination by an expert, a diagnosis before tubal abortion or rupture is sometimes impossible. Usually the condition is not recognized in general practice until hemorrhage has occurred. At this time a history of early pregnancy, a paroxysm of frightful pain, sudden collapse, symptoms of internal hemorrhage, with abdominal distention, and a vaginal examination showing a pelvic tumor with possibly the physical signs of effusion into peritoneal cavity make the diagnosis perfectly clear, and indicate an immediate

[1] Hofmeier claims that the pulsation of arteries on one side of the cervix and not upon the other is a valuable sign of extra-uterine pregnancy; and, moreover, that it is a sign of life in the ovum, ceasing when the embryo dies and the ovum stops growing.

[2] For three or four weeks the tubal tumor is free; quite suddenly it sinks into the pelvis from its increasing weight, and wherever it comes in contact with the pelvic peritoneum the latter is changed into a decidua-like structure to which the tube walls adhere.

celiotomy. These symptoms have been closely simulated by rupture of a varicose vein in the broad ligament, by rupture of an ovarian cyst or torsion of its pedicle, by acute suppurative salpingitis, by fulminating appendicitis with intra-uterine pregnancy, by criminal abortion followed by infection, in which a false history is purposely given, and by pelvic tumors coincident with intra-uterine pregnancy. But as all these conditions demand the same treatment, a mistake in differential diagnosis is not serious. If the cramp-like pains of ectopic gestation lead a patient to consult a physician; if she give a clear history of impregnation; if she present all the earlier signs of pregnancy, with the discharge of blood and membrane which the microscope shows to be decidual; if there is a very sensitive tumor in the neighborhood of the uterus, on which ballottement may, perhaps, be practised, and if the uterus is not so large as it should be,—the diagnosis is justified, and the necessary treatment, also, involving, as it does, a serious operation. Among the conditions in the pelvis that may make the diagnosis impossible are: Abortion, in consequence of or coincident with some growth near the uterus; pyosalpinx, with an indistinct or untrustworthy history of pregnancy; intra-uterine pregnancy, with rapid development of a fibroid on one side of the uterus; development of an impregnated ovule in one horn of a unicornate or bicornate uterus, or on one side of a double uterus; appendicitis complicating intra-uterine pregnancy and cornual pregnancy—the implantation of the ovum in one cornu of the uterus, whence it grows into the uterine cavity, but meanwhile causes such severe paroxysms of pain and distends the uterus so unevenly that interstitial pregnancy is suspected. A common error constantly occurring in general practice is to mistake an extra-uterine pregnancy for an incomplete abortion. I find in my notes of 110 cases this mistake made by the attending physician in 44.[1]

Prognosis.—Without surgical treatment about two-thirds of the cases die; one-third escape the immediate danger of death.[2]

[1] It has been claimed that acetonuria is always present in ruptured extra-uterine pregnancy with intra-abdominal hemorrhage, and that this sign, therefore, is valuable in the differential diagnosis; but acetonuria is so frequent in intra-uterine pregnancy and other conditions that I cannot see its value as a diagnostic sign in ectopic gestation (Baumgarten and Popper, "Wien. klin. Wochenchr.," No. 12, 1906). Moreover, it is not always present in ectopic pregnancy. In ten cases I investigated it was present in four, suspicious in one, and absent in five.

[2] In 265 cases without surgical intervention, 36.9 per cent. recovered, 63.10 per cent. died (Winckel's "Geburtshülfe," 2. Aufl., S. 254). In 100 cases collected by Kiwisch, the mortality was 82 per cent.; in 132 collected by Hecker, 42 per cent.; in 150 by Hennig, 88 per cent.; in 500 cases collected by Parry up to 1876 the mortality was 67.2 per cent.; in 626 cases collected by Schauta, from 1876 to 1890, 241 ended spontaneously, 75 in recovery, and 166 in death, a mortality of 68.8 per cent. Martin states that of 585 cases operated upon, 76.6 per cent. recovered ("Centralbl. f. Gyn.," No. 30, 1892).

Treated by abdominal section, the mortality should be about five per cent., or lower if the operator sees the patient in time. Of the patients who do not die directly in consequence of the tubal gestation, a large proportion remain invalids, and many die at a remote period from various complications, as bowel obstruction, ulceration, suppuration, hemorrhage.

Treatment.—As soon as the diagnosis is established with reasonable certainty, the removal of the gestation sac by celiotomy is the only treatment worthy of consideration. The only safe plan is either to operate immediately one's self, or to refer the patient to a competent surgeon without delay.

The Technic of Abdominal Section for Tubal Pregnancy.—The operation is often performed in an emergency, and must, therefore, be hurried. Plenty of time, however, should be taken to secure an absolutely aseptic condition of the field of operation in the patient, of the surgeon, assistants, dressings, and implements. If possible, the patient should be transported to a well-appointed hospital. If there has been much bleeding and the patient's condition is bad, hypodermic stimulation and submammary injection of salt solution should precede the operation, the anesthesia should be limited and the operation should be finished in the fewest minutes possible. It is possible to conclude the operation, to the last abdominal stitch, in less than eleven minutes and with less than an ounce of ether. No attention should be paid to the blood that gushes in enormous quantities from the abdominal cavity when the peritoneum is incised. It has already been shed and is of no use to the patient. The side affected should have been learned by the history,[1] if not by the physical signs. This tube should at once be grasped between the thumb and fingers of one hand, the tube should be cut from the cornu, the broad ligament should be transfixed by a pedicle needle to the inner side of the round ligament, and ligated *en masse* with three turns of the catgut ligature, one to each side of the pedicle needle, the third around the whole stump. The turns of the ligature nearest to the uterus lie under the severed end of the tube so as to leave no stump. The tube and ovary are then cut away. The cornu is sewed with a double tier stitch of catgut. The abdominal cavity is flushed with a large quantity of sterile water[2]

[1] It is often impossible to tell from a physical examination which tube is involved, but I have found the history of pain down *one leg* and not the other of great value in diagnosticating the side affected.

[2] I have practically given up douching the abdominal cavity after abdominal sections, except in extra-uterine pregnancy. There is no other means which so rapidly and surely removes blood-clots from the abdomen. It is, moreover, a great advantage to leave the large quantity of hot water which remains in the abdominal cavity after irrigation. Gallons are required, and it is inconvenient to prepare such a quantity of normal salt solution. There is, moreover, no disadvantage in the use of sterile water.

or normal salt solution. Drainage is rarely necessary. The author has not drained a case for some years, though formerly he drained every one. If drainage is deemed necessary, gauze packing should be used. For twelve or twenty-four hours after the operation vigorous stimulation and an active treatment for the acute anemia are necessary if there has been profuse hemorrhage. Submammary or intravenous injections of normal salt solution are invaluable. If the operation is performed before rupture or after a moderate hemorrhage from a tubal abortion its technic does not differ from the salpingectomy for other indications.

The author would warn the inexperienced against waiting for reaction in cases of ruptured tubal pregnancies with profuse hemorrhage. Delay has been advocated, but could not be endorsed by any one with a large and varied experience. Reaction usually does not occur. The patient continues to bleed until she bleeds to death.

The vaginal operation for tubal pregnancy in the first three or four months has the serious disadvantages that, on account of uncontrollable hemorrhage, a vaginal hysterectomy or hasty abdominal section may be necessary, and if the tube is simply incised and not removed, a diseased and useless pelvic organ is left behind to be the source of future trouble. It is impossible through a vaginal incision to evacuate the blood and blood-clots lying in large quantities in remote portions of the abdominal cavity. Moreover, as in all vaginal sections, nicety and precision of work is impossible through the vaginal vaults.

In *interstitial* pregnancy, on account of the difficulty of diagnosis, treatment is not usually attempted until rupture and hemorrhage have occurred, when an abdominal section must be performed. The sac should be emptied, and its edges should be sewed to the abdominal wall; after the bleeding vessels are secured, the sac should be drained. If this technic is impossible, ligation of the uterine and ovarian arteries is indicated, drainage of the sac, or possibly supravaginal amputation of the uterus. It is justifiable, if the diagnosis is clearly established, to evacuate the gestation sac into the uterine cavity after thorough dilatation of the cervical canal. A mistaken diagnosis, however, would lead to a premature termination of a normal intra-uterine pregnancy. Tait describes a case in which he found it possible to incise the sac, turn out its contents, and drain it, after fetal death.[1] Engström treated a case successfully by incising the uterine wall, extracting the dead fetus and its appendages, making and enlarging an opening between the gestation sac and the uterine cavity,

1 London "Lancet," 1894, 1, p. 38.

sewing the uterine wall firmly together, as after a Cesarean section, and closing the abdomen without drainage.[1]

Ovarian pregnancy is treated by excision of the sac with the ovary. As a matter of fact, the operation is undertaken in these rare cases for an ovarian tumor, and the operator discovers its contents, to his surprise, after opening the abdomen.

In advanced extra-uterine pregnancy the *fetal sac* should be enucleated and extracted whole when the fetus is viable. It may be necessary to cut the cord off short, stitch the sac wall to the abdominal wall, and drain the sac. Forty operations (1889–1896) after the seventh month of gestation, with living and viable infants, were collected by Dr. R. P. Harris.[2] In this number there were ten maternal deaths; twenty-seven infants survived the operation. Von Both has collected 83 cases: in the first 30 operations there were 25 deaths; in the 53 following, 15; and in the last 8 operations, only 1.[3] Sittner's[4] statistics show from 1887 to 1900 forty-eight operations with removal of placenta and fetal sac with a mortality of 12.5 per cent.; thirty-five operations during the same period without the removal of the placenta, with a mortality of 42.8 per cent. In the last five years of the period the mortality of the two procedures was respectively 5.5 per cent. and 33 per cent. In a later article Sittner presents the statistics of 121 cases. From 1901 to 1906 the mortality of removing the whole sac was 5.7 per cent.; of the removal of the placenta, leaving the sac behind, 30 per cent. *When death of the fetus has occurred* the fetus and its entire surrounding sac should be removed. If the exsection of the sac is found to be difficult or dangerous, on account of hemorrhage, the implantation of the placenta on the intestines, or its inaccessibility, it is permissible, some weeks after fetal death, to cut the cord off short, leaving behind the atrophied remains of the placenta. If this is done, the sac-wall should be stitched to the abdominal wall, and thus drained for a length of time until the placenta comes away. Meanwhile daily irrigations are required and antiseptic powders (tannic or salicylic acid) may be dusted in the sac-cavity. In case the gestation sac is low down in Douglas's pouch, bulging the posterior vaginal wall, vaginal section and the delivery of the fetus by the natural passage may be considered; but the dangers and disadvantages of the vaginal operation should be carefully

[1] "Centralbl. f. Gyn.," No. 5, 1896. Werth, to 1904, has collected 31 operations for interstitial pregnancy, "Winckel's Handbuch," 2^2, p. 940.

[2] Kelly's "Operative Gynecology," vol. ii.

[3] "Centralbl. f. Gyn.," No. 15, 1899.

[4] "Arch. f. Gyn.," Bd. lxiv, lxxxiv, H. 1. W. R. Nicholson, "Am. Jour. Obstet.," No. 6, 1908.

weighed; these are: Difficulty of extracting the fetus, if it is large, uncontrollable hemorrhage, puncture of an intestine, infection of the general peritoneal cavity, either at the time of the operation, or in subsequent irrigations of the sac, and adhesions involving the uterus and appendages after the woman's recovery from the operation.[1] Vaginal section is indicated in case of an old gestation sac undergoing suppuration and containing a much macerated or disintegrated fetus. In some cases of intraligamentary pregnancy it is possible to open the sac extraperitoneally by an incision above Poupart's ligament. It is always advisable, however, to make a preliminary abdominal section to learn the relations of the gestation sac.

Pregnancy in One Horn of a Uterus Bicornis or Unicornis.—Pregnancy in an ill-developed horn of a uterus unicornis may exactly resemble a tubal or interstitial pregnancy, and will probably end in rupture at the apex of the cornu.[2] This is particularly

Fig. 210.—Pregnancy in the rudimentary horn of a uterus unicornis, which has become, secondarily, abdominal (author's collection, Obstetrical Museum, University of Pennsylvania).

true if the impregnated ovule develops in a rudimentary horn, in which the conditions are almost the same as in a tube, except that rupture takes place later. A pregnancy in a uterus bicornis may possibly terminate prematurely, or even at term, by expulsion of the product of conception through the natural passage. There may be a coincident pregnancy in the rudimentary horn and in the better developed one; after the removal of the former the latter may progress to term.[3]

[1] For a good bibliography of the removal of extra-uterine fetuses through the vagina and by the rectum, see J. T. Winter, "Am. Jour. Obstet.," 1892, p. 34.

[2] Three cases of pregnancy in rudimentary horns are reported by Turner, Werth, and Solin (Lusk's "Obstetrics"). Kussmaul collected thirteen cases; Mannierre 39, 24 of which ended fatally by rupture, "Am. Gyn. and Obst. Jour.," vol. xv, No. 3. Werth gives the number published to 1904 as an even hundred, "Winckel's Handbuch," 2^2, p. 984.

[3] Doran, "Journ. of Obst. and Gyn. of the Br. Empire," June, 1906.

The diagnosis of pregnancy in a uterine horn is difficult or impossible. It is mistaken, usually, for tubal gestation. The removal of a gestation sac in a rudimentary uterine horn is commonly easy, as a convenient pedicle is formed by the attachment of the horn to the lower segment of the better-formed half of the uterus.

Hydrorrhea Gravidarum.—A watery discharge from the vagina of a pregnant woman may have four sources: catarrhal endometritis, rupture of the membranes, discharge of fluid from a hydrosalpinx (*hydrops tubæ profluens*),[1] and edema of the uterine walls. The last is a very rare cause indeed, and I am somewhat skeptical as to the possibility of serum leaking from the uterine walls, but it has apparently happened in a few cases.[2] In catarrhal endometritis the fluid is discharged suddenly in considerable quantities; it reaccumulates and is again discharged, the recurrent hydrorrhea continuing, perhaps, until term, although usually after the second or third discharge labor is brought on. The fluid discharged in a case of catarrhal endometritis is thin mucus. In a typical case under my observation there was a discharge of more than a pint of fluid at the seventh month of pregnancy, while the patient was lying quietly in bed. It was supposed that the membranes had ruptured and that labor was imminent, but no pains appeared, and after confinement to bed for a week the patient was allowed to get up. A month later there was another profuse discharge,—certainly more than a pint,—again occurring while the patient was quietly at rest in bed. Twelve hours later labor-pains appeared; in the latter part of the second stage of labor the membranes ruptured and about a quart of liquor amnii was discharged. A careful examination of the membranes failed to detect a perforation remote from the seat of rupture.

Rupture of the membranes and the discharge of liquor amnii in pregnancy are commonly followed by labor-pains within thirty-six hours. It is not very unusual, however, for three or four days to elapse from the time of rupture to the onset of labor. I have several times seen a month intervene between the rupture of the membranes and the beginning of labor, and in one case under my care the membranes were perforated at four and one-half months without inducing labor. The patient was the wife of an English officer in India. She had been told by a skilful Indian masseuse that she was pregnant, but an English physician

[1] "Hydrorrhœa Gravidarum and Hydrosalpinx," Cowles, "Obstetrics," Nov., 1899.

[2] Chazan, "Centralblatt. f. Gyn.," No. 5, 1894, p. 105.

whom she consulted assured her she was not, and, to prove that he was correct, inserted a sound into the uterine cavity. There was immediately a gush of liquor amnii. In spite of a journey of some 1500 miles from the interior to the coast, the long voyage from India to England, and thence to the United States, liquor amnii flowing from the vagina at every roll of the ship or jolt of a carriage, labor did not appear until term, four and a half months from the time the membranes were punctured. There was found, after delivery, a round, regular opening in the membranes, about the caliber of a lead-pencil, midway between the seat of rupture and the placenta, which was attached at the fundus.

PART II.

THE PHYSIOLOGY AND MANAGEMENT OF LABOR AND OF THE PUERPERIUM.

CHAPTER I.

Labor.

This chapter deals with an important practical subject,—the management of a woman in labor. The questions involved in this study confront every practitioner of medicine at some time. Every physician is popularly supposed to be able to manage a labor, and such cases are among the first that he is called upon to attend. To a beginner in obstetric practice there is much that is embarrassing. The novel and intimate relations with his patient; her evident dread of the necessary examinations more or less revolting to every woman; the doctor's keen consciousness of a lack of experience; mistrust of his capacity to recognize the stage of labor, the presentation and position of the fetus; the knowledge that his every movement is watched by critical friends or attendants of the patient, who possess, perhaps, just what he lacks,—practical experience,—all unite to produce a most unenviable frame of mind in the practitioner attending his first few cases of labor. Some consolation, however, can always be found in the reflection that labor is a natural and a comparatively easy process, in the large majority of cases; that a physician's duty is one mainly of inaction and non-interference, and that most probably the labor will terminate fortunately for mother and child, in spite of his inexperience. But it is evident that no one can predict what may occur in any given case. There may suddenly arise some accident of the gravest nature, which must be immediately recognized and promptly treated. It is under such

circumstances that a physician's education and knowledge are put to the test. It is plain, therefore, that in a work on obstetrics it must be the writer's aim to impart the requisite knowledge to cope with all sorts of dangerous emergencies. This consideration makes it necessary to dwell at length upon all the possible complications, accidents, and difficulties of the child-bearing process, leaving upon the student's mind the impression that parturition is a more dangerous process than is really the case. It is well to recollect, therefore, that nature alone, in the majority of cases, with very little artificial aid, is capable of terminating safely the birth of the child; but at the same time it should not be forgotten that at any moment a dangerous complication may occur, which must be immediately recognized and promptly dealt with.

It is convenient to begin the study of labor with a definition of the process.

Labor is that natural process by which the female expels from her uterus and vagina the ovum at its period of full maturity, which is reached, on the average, two hundred and eighty days after the first day of the last menstruation. The process is divided into three main stages or acts,—the expansion of the birth-canal, the expulsion of the fetus, and the delivery of the remainder of the ovum.

Why labor occurs at the end of two hundred and eighty days has given rise to endless speculation in all ages of medicine.[1] Several explanations may be offered. The period of two hundred and eighty days, or forty weeks, or ten lunar months, must at once direct attention to the fact that labor comes on at the tenth menstrual period since pregnancy began. At the menstrual period in the non-pregnant uterus there is always distinct muscular action, induced probably by the presence of a foreign body—blood—in the uterine cavity. During pregnancy it has long been known that by the unconscious memory of living tissue there recurs, at regular intervals corresponding to the menstrual period, a disposition to muscular action, which is sometimes so exaggerated as to bring about an expulsion of the ovum,—an accident especially to be feared at such times in women prone to abort. This cause of labor is described conveniently as *periodicity.*

[1] Hippocrates explained the onset of labor by the hunger of the fetus, which impelled it to make its exit from the womb to seek something to eat. The following explanations have been offered in recent times: thrombosis of the veins at the placenta site; excess of CO_2 in the maternal blood; excess of CO_2 in the fetal blood; deficiency of CO_2 in the blood; pressure upon the ganglia in the supravaginal portion of the cervix; excess of urea in the blood, etc. See Blumreich, "Experimente Zur Frage nach den Ursachen des Geburtseintrittes," "Arch. f. Gyn.," Bd. lxxi, H. 1.

The hollow muscles in the body admit of distention up to a certain point, but, that point being reached, they are immediately stimulated to contraction. This is well illustrated in the stomach of the young infant, which nurses until the organ, overfilled, contracts and expels the excess of food which its cavity cannot contain. The same action is seen in the pregnant uterus. It admits of distention up to a certain point, until it is well filled by the mature fetus, when the great tension of its walls, no longer endurable, stimulates them to muscular action which terminates in the expulsion of the ovum. This cause of labor is defined as *overdistention of the uterus*.

In the human ovum that has reached full maturity there occurs a degenerative process, a fatty change, in the connections which bind the ovum to the uterus, that brings about a separation more or less extensive between the uterine wall and the ovum, and the latter, becoming a foreign body in the uterine cavity, is cast off.

This cause of labor is called *the maturity of the ovum*.

Finally, heredity, the unconscious memory of tissue transmitted from generation to generation, plays an important rôle in the causation of labor. Thus, at the end of two hundred and eighty days the fetus has reached such a size that it is just possible for the woman, at the expense of much effort, to expel it through the birth-canal. Had it grown much larger, its expulsion would be difficult or impossible. On the other hand, an infant born much before two hundred and eighty days is not sufficiently well developed to endure the lower temperature that it encounters, and the necessity for obtaining its own nourishment and oxygen, and consequently it may not survive. Therefore, it is plain that only those women who gave birth to their offspring about the two hundred and eightieth day of pregnancy could successfully perpetuate the human species. Those that fell in labor later probably died; those whose young were born earlier were not able to rear them; and so the habit of bearing children at the end of forty weeks from conception, transmitted from generation to generation through many ages, became, perhaps, the most powerful influence in determining the duration of pregnancy.

To recapitulate, then, labor comes on at about the two hundred and eightieth day from the beginning of the last menstrual period, by reason of the influence of periodicity; the overdistention of the uterine cavity; the maturity of the ovum, and heredity. All these causes being operative together, it requires a slight stimulus or none at all to inaugurate effective uterine contractions. Ex-

ercise, a dose of purgative medicine, a jolt or a jar may provoke muscular action on the part of the uterus that ends in the expulsion of the child. This knowledge is sometimes put to practical use. If it is desirable that labor should not be delayed, a dose of castor oil the night before the expected date and 15 grains of quinin the next morning, especially in primiparæ, often bring on effective pains.

Before entering upon a study of labor the student should be sure that he is able to recognize its occurrence.

The diagnosis of labor, therefore, is a necessary preface to the study of its physiology and management. First and foremost, in the woman supposed to be in labor, the existence of pregnancy should be determined. Many ludicrous and some tragic errors have been due to a disregard of this rule.[1] There is a valuable premonitory sign of labor which should always be inquired for: the subsidence of the uterine tumor at periods varying from four weeks in the primigravida to two weeks or less in the multigravida before the actual advent of labor. This sinking of the uterine tumor is the result of the engagement of the lower uterine segment with the presenting part of the fetus in the superior strait and in the cavity of the pelvis. It has its cause, probably, in the action of the muscles inclosing the abdominal cavity. Just as the stomach, the heart, and the uterus bear distention up to a certain point, so the abdominal muscles allow a certain distention of the abdomen to occur, but resent anything beyond it. This point is reached in primigravidæ at about the thirty-sixth week of pregnancy, but later in multigravidæ owing to a greater laxity of their muscles. The abdomen being distended to its utmost, the abdominal muscles contract vigorously and drive the lower part of the uterus down through the superior strait into the cavity of the pelvis by diminishing the area of intra-abdominal space, thus accomplishing the first step in the expulsion of the child, the passage of the head, presuming it to be a cephalic presentation, through the superior strait, long before the labor itself begins. This sinking of the fetus and uterus occurs often suddenly, so that the pregnant woman may rise one morning entirely relieved of the distressing abdominal pressure symptoms that had previously,

[1] One of my students, on duty in the out-patient obstetric department, receiving his first call, hurried to the woman's house, spent some fifteen minutes sterilizing his hands, and made a prolonged vaginal examination, much to the patient's surprise, as she had sent for a physician on account of rheumatism. She was not pregnant.

On one occasion I figured as an expert witness in a trial for damages on account of an attempted Cesarean section. The patient, a rachitic dwarf, was not even pregnant when the operation was performed.

perhaps, tormented her. But the relief in one direction is followed by an aggravation of the varices about the vulva, anus, or lower limbs, by neuralgic pains extending down the thighs, by increased vaginal secretion,—all due to the greater pressure within the pelvic cavity. So constant is this phenomenon, the descent of the pregnant uterus near term, that, should it fail to occur, some cause for the failure should be looked for. It is usually found to be a malposition of the fetus or a deformity of the pelvis.

There are three signs indicating that labor has actually begun: (1) Recurrent pains of characteristic duration, situation, and nature; (2) the escape of a small quantity of blood-tinged mucus from the vagina, and (3) the dilatation of the os. The characteristic pains of commencing labor recur at intervals of from five minutes to half an hour, usually being about fifteen minutes apart. The pain is located in the abdomen, or is described as passing from the umbilicus in front to the sacrum behind, or in some cases is confined altogether to the back. It comes on suddenly. The woman is walking about the room, or perhaps conversing, when suddenly she pauses, bends over, contorts the facial muscles, sets her lips, and clinches her teeth. The pain rarely lasts more than a minute; when it passes off the woman resumes her interrupted occupation. If the hand were laid over the abdomen when the pain came on, the uterus would be felt as a firm, hard, well-defined body, more globular than in its relaxed condition.

As a consequence of the dilatation of the internal os, the lower portion of the ovum begins to sever its connection with the uterine wall, small blood-vessels are torn, and there is a slight oozing of blood, which stains the large plug of tenacious mucus that has filled the cervical canal during pregnancy. The cervix being gradually obliterated from above downward by the descending ovum, the blood-stained plug of mucus is expelled from the cervix into the vagina, whence it escapes externally and becomes what is popularly called the *show*, which is regarded, and rightly, too, as a valuable sign of beginning labor. But the uterus may contract quite vigorously and bloody mucus may escape externally in many a case when labor has not really begun. The most reliable sign, after all, is the obliteration of the cervical canal and the dilatation of the os. If these conditions become plainly appreciable, one may safely diagnosticate a beginning labor, although it would be well to bear in mind exceptional cases in which the os has actually dilated up to an inch or more, but has afterward

retracted and remained undilated until true labor finally appeared.[1]

Having made a diagnosis of beginning labor, the physician is immediately plied with questions by the patient or her family as to its probable duration. This is a question that is put to every practitioner of obstetrics in almost every case, but, unfortunately, it can not be given a definite answer. It is a common experience to see a variation in the length of labor from one hour or less to many hours ; indeed, in rare cases to a week or more. So that it is impossible to predict with any degree of accuracy how long a given labor might last. One can usually obtain an approximate idea, however, by bearing in mind the average duration of labor in multiparæ, eight hours, while in primiparæ the time is usually double that or longer. One should recollect that a large parturient canal with a normal fetus, or one undersized, along with vigorous muscular action, means a quick labor ; that the opposite conditions mean delay. In the case of multiparæ one should always inquire into the history of past labors, for many women have marked individual peculiarities in regard to the duration of parturition, in some the process being usually rapid and easy, in others the reverse. A consideration of all these factors will enable one to form some definite idea in his own mind of the probable duration of labor, but he would do wisely to keep his opinion to himself. To the inquiring family a non-committal statement should be made, such as "the length of the labor will depend on the strength of the pains."[2]

Before proceeding to a consideration of the management of labor, the student will find it of service to observe the process as a passive spectator. Nothing is so conspicuous in the first stage of labor as the contractions of the uterine muscle. It has been asserted that the uterine walls contract in a sort of peristaltic wave, beginning at the cervix, running up over the fundus, and returning again to the cervix ; but this action has never been actually demonstrated, and it is more convenient, if, indeed, it is not strictly correct, to regard the uterus as a hollow muscle

[1] I have seen a young primigravida with the os dilated so that I could put four fingers side by side into it, and with the membranes bulging into the vagina, who walked about the house for a week in this condition before labor-pains appeared. In this and in similar cases, however, the cervical canal was not effaced.

[2] As those labors which end in the day-time often begin at night, and vice versâ, an obstetrician's rest is disturbed in a very large proportion of his cases. There is, consequently, a prevalent idea that almost all confinement cases occur at night. As a matter of fact, forty per cent. only are delivered between the hours of 11 P. M. and 7 A. M., according to the statistics of West, based on 2019 cases ("Amer. Med. Jour.," 1854).

which contracts at once and equally in all its parts. The effects of these contractions are : (1) To drive the liquor amnii in the direction of least resistance, which is through the internal os into the cervical canal, where, contained in the membranes, it dilates the cervical canal in the very best manner for the maternal tissues, as a hydrostatic dilator. (2) To drive down the fetal mass in the same direction by diminishing the area of the intra-uterine space. (3) To distend the lower uterine segment and upper cervical canal by mechanical pressure, and, finally, to dilate the os in the same manner after the circular, sphincter-like muscle of the cervix has been paralyzed by stretching and prolonged pressure. The average duration of the uterine contractions during labor is one minute. The intervals between them decrease as labor goes on, and the pains become more powerful until, finally, there should intervene between them but two or three minutes. No one could observe the process of parturition in the capacity of a scientific observer without regarding the *action*, *appearance*, and *condition* of the woman. It will be found that her whole bearing and manner present two distinct types in the course of the process. At first the advent of each pain is announced by a sudden setting of the teeth, a distortion of the facial muscles, suffused eyes, and a flushed face, and, the pain increasing in intensity, she suddenly emits a sharp cry of pain. The woman, if in bed, assumes almost any attitude that is most comfortable to her. In a normal first labor of some seventeen hours' duration, this condition of affairs lasts about fifteen hours, when a marked change may be observed in the woman's action. If she were left entirely to herself she would be very likely to assume a squatting posture in bed or upon the floor,—a position assumed by the women of many savage tribes during the latter stage of labor. Now, as a pain comes on the woman draws a deep breath, clinches her teeth, fixes her diaphragm, and evidently, from her behavior, calls into play the action of the abdominal muscles with all her might. Her face is suffused, the eyebrows knit, and beads of perspiration stand out upon her brow. As long as the breath can be held this straining action is continued, until the air is suddenly expelled from the lungs with a characteristic grunting sound, the diaphragm is again relaxed, and the abdominal muscles cease for a moment to act until a full inspiration is taken, when the straining again begins, and continues until the uterine contraction passes off. If a vaginal examination were made at this time, a reason would be found for the change in the clinical aspect of the case. It would be discovered that the os is fully dilated and that the presenting part is begin-

ning to descend, either carrying the membranes before it or else, as is more common, the membranes rupture just as the os is

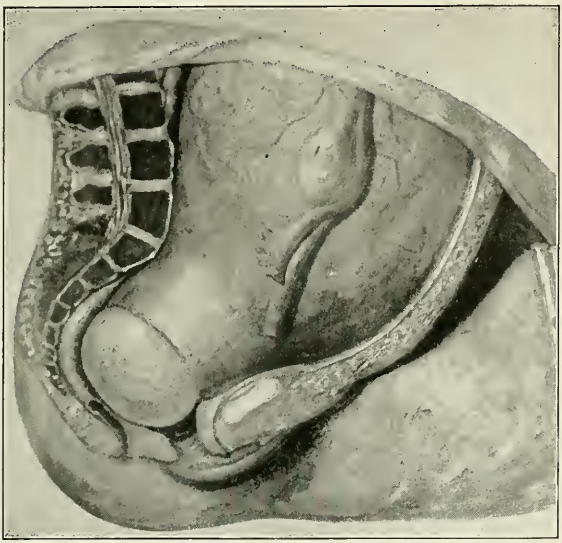


Fig. 211.—The bag of waters or pouch of membranes.

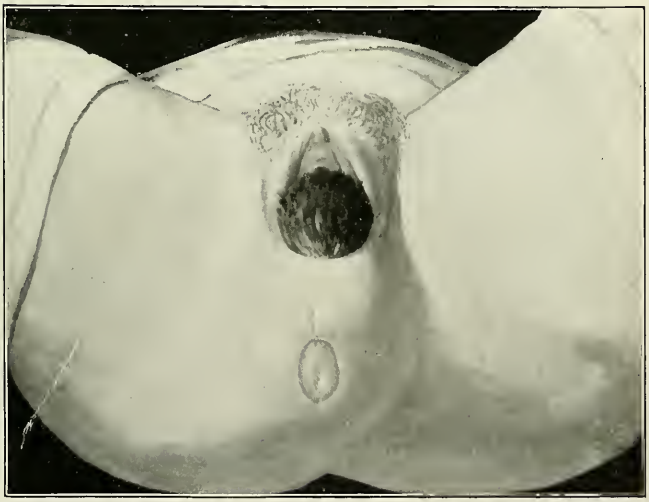


Fig. 212.—The distention of the vulva and the appearance of the child's scalp.

fully dilated and the child's presenting part is driven through the rent in the amnion and chorion. In this condition of affairs

is found a good explanation for the action of the abdominal muscles; so long as the presenting part acts simply as a wedge, dilating the os, but not descending to any appreciable degree, the muscles of the abdomen are useless, and are, in fact, inhibited, for their action would drive the presenting part against the undilated cervix with such force as to give great pain, if not to do

Fig. 213.—The escape of the head and the resumption of its oblique position (external restitution).

great damage. The main obstruction to the descent of the child, the cervix, being removed, the abdominal muscles are called into play, and act effectively in the displacement of the fetal body downward along the birth-canal. For convenience definite names are given to these stages of labor, presenting each such distinctive features. The period of dilatation is called the first stage; the period of descent or expulsion is called the second stage. The first stage begins with the onset of labor and ends with the complete dilatation of the os. The second stage begins with the dilatation of the os and ends with the

complete expulsion of the child. As labor is not complete until the whole ovum is expelled, there is a third stage of labor, that period of time from the extrusion of the fetus until the placenta and membranes are expelled.

To return to the clinical phenomena of labor. The woman has passed from the first to the second stage. As the latter progresses the pains become more frequent and more violent, the suffering is increased, and her complaints grow

Fig. 214.—The transverse rotation of the head (external rotation).

louder. Finally she declares, perhaps, that she must rise to evacuate her rectum and bladder, and the reason for this feeling is clear when one sees the perineum bulging far outward, the anus widely dilating, the rectum becoming slightly everted, and the presenting part, the head, filling up the whole lower part of the pelvis and pressing as firmly on the bladder in front as it does on the rectum behind. And now, with his eye upon the vulva,—for this part of the labor, in the best interests of the

patient, ought always actually to be observed, both in a scientific study of the process and in its management,—the physician sees the labia separate during a pain and the child's scalp come into view, but, with the subsidence of the pain, disappear. With the next uterine contraction a little more of the head appears, again to disappear as the pain passes off, and so on with every pain for perhaps twenty minutes or an hour, although every time, as more and more of the head appears, it looks to the inexperienced observer as if that pain must be the last, until

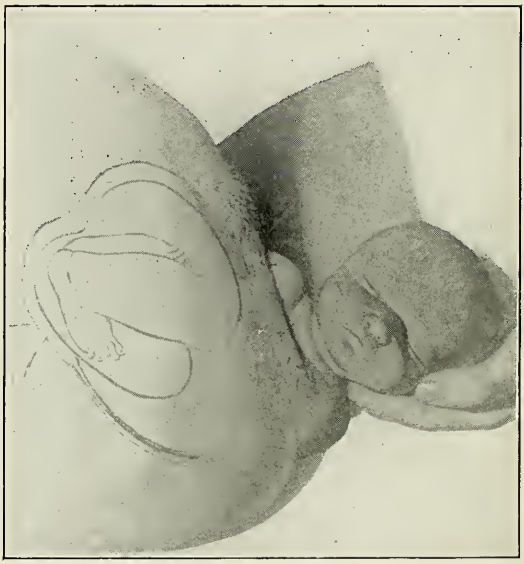


Fig. 215.—The support of the head and the escape of the anterior shoulder.

finally the vulva is stretched to its utmost limit and the largest diameters of the head are engaged, when, with a sudden shriek of pain from the woman, the child's head is born. There comes then a pause in the uterine action ; the head may protrude from the vagina for a minute or much longer, while the woman's natural powers are being recuperated, after their tremendous exertion, for a fresh effort. Meanwhile, the child's face turns immediately after birth toward one or the other tuber ischii, and from the constriction about the neck becomes livid, and it seems that the child's life is threatened by strangulation. The medical attendant feels at first an almost irresistible impulse to pull on the head and terminate labor. But this is a useless, indeed, a reprehensible procedure, for the child is perfectly safe, its respiration still going on normally in the placenta, and to ex-

tract the shoulders rapidly through the overstretched and bruised maternal tissues is almost certain to lacerate the perineum. Moreover, the child is insensible at this time; it has been almost comatose during its passage through the pelvic canal, and is now recovering, its brain-centers, especially that of respiration, becoming ready to respond to the stimulus to act when the child is born. Any unnecessary interference, therefore, at this stage of labor may harm both mother and child. The woman's uterus having regained power, in a few minutes begins to contract. The abdominal muscles aid it. The child's face turns still more to one side or the other until it looks quite transverse. The expulsive force still acting, the anterior shoulder appears under the symphysis pubis, the posterior shoulder shortly afterward sweeps over the perineum and escapes; the anterior shoulder follows it, and the rest of the body, too small to present any longer an effective resistance, is expelled immediately and the child is born. Its birth is announced, as a rule, at once by a lusty cry, which expands its lungs and initiates the pulmonary respiration. Immediately after the expulsion of the child the woman becomes perfectly quiet and composed, no matter how noisy she may have been before. The passive pleasure of relief from suffering is so great that it becomes a positive enjoyment simply to be quiet, and the woman does not wish to be disturbed. In the course of some fifteen or twenty minutes, in a perfectly natural and normal case, such as is now under description, the patient again experiences pain; the uterus is again contracting, and the woman is again instinctively aiding it with her abdominal muscles, until after one or two such pains the placenta with the membranes is expelled.

The manner in which the placenta is separated from the uterine wall and is expelled from the uterine cavity is a matter still under dispute, and there is the greatest difference of opinion in regard to it. "If," says Dr. Berry Hart, the distinguished obstetrician of Edinburgh, "the delivery of the placenta depended upon obstetricians knowing how it separated, no woman in labor would complete her third stage." To explain the first phenomenon, the separation of the placenta, many theories have been advanced, of which I shall give only the three most reasonable, each of which has its prominent adherents. These three theories are: (1) The diminution in the area of the placental site; (2) the detrusion theory, which is founded on the belief that the uterus seizes the placenta and pushes it off from the uterine wall; and (3) the theory that an effusion of blood occurs behind the placenta, and that this "retroplacental effusion," as it is called,

pushes off the placenta from the uterine wall. Of these three theories, I am an adherent of the first. In a strictly normal case the retraction of the placental site is alone sufficient to account for the separation of the placenta. It has been demonstrated that, as the uterus contracts, the placenta follows the retraction of the uterine walls up to a certain point without becoming detached, until the placenta is reduced to about one-half its natural size. Now, this is easily explained if one recollects the structure of the placenta, like a sponge, with its branching villi and intervening blood-spaces. But as soon as these villi are squeezed together so that the placenta forms one solid mass, it can no longer follow the retraction of the uterine wall, but is that moment, in a typically normal case, sprung off from its attachment to the uterus, and is for a varying period of time loose within the uterine cavity, until, acting as an irritating foreign body upon the uterus, it is finally driven out into the cervical canal and upper part of the vagina by the uterine contractions that its presence within the uterus excites. In the cervix and vagina, however, the placenta may remain a long time without exciting the benumbed and almost paralyzed muscles of these regions to action. And thus it is that, in civilized women, at least, it is often impossible to leave the third stage of labor entirely to nature, for the placenta may remain so long undelivered that its succulent mass may putrefy and so become a source of septic infection. In describing a perfectly normal case of labor, I must presume that the placenta is expelled by the natural forces, and must describe the manner of its expulsion. But here, again, one encounters the greatest difference of opinion, even about so apparently simple and trivial a matter. One set of observers, led by the English obstetrician, Matthews Duncan, declares that in natural labor the placenta comes out edgewise, and that any other mode of exit indicates something abnormal; while Schultze, of Germany, and his followers declare that the placenta always escapes like an inverted umbrella. My observation compels me to adopt the latter view.

In consequence of the enormous effort put forth, the nervous excitation, the acute suffering, and the injury inflicted upon the soft structures of the birth-canal, it is not surprising that systematic thermometry of the recently delivered woman shows almost always some elevation of temperature in the first twelve or twenty-four hours after child-birth.

After a brief observation of the main clinical phenomena of labor, the student is better prepared to take up a consideration of its management. The advice offered applies to private and not to hospital practice, and to the beginning of the process. In

the vast majority of cases a physician is engaged to attend a woman in confinement a considerable length of time before labor is expected, and there are points in the preliminary management of the patient which it is important to appreciate, but they have been considered in the section upon the management of pregnancy. The present section begins with the first intimation that the doctor receives of beginning labor, the summons to attend his patient in confinement. The call may come at the most inconvenient time,—late at night; in the early hours of the morning; at the beginning of a meal; in the midst of a press of other work,—but no one should practise obstetrics who does not make it an inflexible rule to give such a summons precedence over everything, over personal convenience and all other engagements.

It is customary, in this connection, to offer advice to young practitioners in regard to their personal demeanor and appearance when about to attend a woman in labor. While such advise is usually superfluous, it does no harm to remind the physician of the especial requirements of obstetric practice. He should remember that the irritability and increased sensibility characteristic of pregnancy are even more exaggerated during labor. Any unusual appearance in the medical man—slovenliness of dress, abruptness of speech and manner, harshness of voice, the odor of liquor on his breath or of tobacco in his clothing —may disgust his patient. Bearing in mind the increased sensitiveness of women in labor, recollecting that the agony which they are about to endure, and that the despondency due to dread of impending suffering, if not of death, demand the greatest sympathy and consideration, no one fitted by nature for the practice of medicine will go far astray in his conduct toward his parturient patients.

A more important question arises as soon as a physician is summoned to a case of labor. What shall he take with him? As a part of his management of the pregnant woman he has directed the patient or her friends to have at hand the articles enumerated in the list of directions to mother and nurse on pages 374–376. A well-equipped obstetrician should take with him in his obstetric bag, to an ordinary case of confinement, the following articles:

1 razor.
Nest of basins (3).
2 brushes. 4 towels.
1 metal tube for sterile cotton, vulva pads and packing.
1 gown.
1 tube unguent.
2 pair rubber gloves.

1 clinical thermometer.
1 hypodermic syringe.
1 douche bag, glass nozzle, and rectal tube.
1 bottle containing eye wipes, pipet, and boric acid solution (gr. xv to oz.).
1 jar containing umbilical tape.
1 jar containing soft soap.
1 bottle ergot.
2 ampoules of ergotin for hypodermic injection.
1 bottle nitrate of silver (1 per cent.).
1 bottle bichlorid tablets.
1 powder shaker, containing powder for umbilical dressing (1 part salicylic acid to 8 parts starch).
1 package of umbilical cord dressing.
1 sterile catheter.
1 hypodermoclysis needle.
1 bottle tablets for making normal salt solution.

CONTENTS OF INSTRUMENT PAN.

1 pair Simpson's forceps.
1 tenaculum forceps.
1 intra-uterine catheter.
2 hemostatic forceps.
1 curet forceps.
2 needles.
1 tube catgut.
1 dressing scissors.
1 umbilical scissors.
Alcohol lamp and stand.
Small instrument tray.

This is the equipment furnished my students in the outpatient department of the University Hospital. The basins, brushes, towels, gown, gloves, douche bag, cord dressing, and catheter are done up in separate packages, covered with muslin, and sterilized in the autoclave. The metal tube and powder shaker, with their contents, are also sterilized.

Arrived at the dwelling to which he has been summoned, the physician finds the woman in the room selected for her confinement, which should be, if possible, the sunniest and best ventilated in the house, and in care of a nurse in whom he has confidence from past acquaintance or from good recommendation. He has been summoned because the woman believes herself to be in labor, but she may be mistaken, or, on the other hand, may be much farther advanced than she imagines. It is the physician's first care to determine this point, and to do it he must make an examination. This the patient fully expects and will in no way object to, but it must be done in a manner as little revolting to her feelings as possible. After a few indifferent

remarks in a quiet tone to the patient; a few questions in regard to the time the pains first came on, their duration, character, and situation, and the intervals of time between them ; after feeling the pulse, perhaps, and looking at the tongue, and assuring her that her general condition is very good indeed, the nurse is informed that the patient is to be prepared for abdominal palpation. While the nurse is arranging the patient on her back with a single layer of some thin material, as a bed-sheet, spread smoothly over the abdomen, the physician himself either leaves the room or turns his back upon the bed while he dons a surgical gown and gives his hands a preliminary washing.

This whole subject of the obstetric examination is so important that space may well be devoted to its consideration.

Abdominal palpation is described fully in the chapter upon The Mechanism of Labor. It is, therefore, only necessary to state here that, after determining the position of the fetus *in utero*, and investigating its condition by listening to the heart-sounds, the nurse is directed to place the patient upon that side toward which the fetal back is directed and to prepare her for a vaginal examination. For this purpose the parturient woman is placed upon her side, with the hips brought well to the edge of the bed, the thighs flexed upon the abdomen, the legs upon the thighs. The clothing is rolled up above the waist, or so arranged that it shall not interfere with the access of the examining hand, and the bed-sheet is draped over the patient so that a wide margin of it falls over the side of the bed. While this is attended to the physician is cleansing his hands by a method described in the chapter on Aseptic Technic (p. 778). In addition to the hand disinfection, it should be an invariable rule to wear rubber gloves that have been boiled, steamed, or soaked in a 1 : 1000 sublimate solution.

The physician uses the hand for the internal examination next the patient, as he takes a seat beside the bed, facing her genitalia. Everything being in readiness for the vaginal examination, the examining finger is dipped into a jar of carbolated vaselin, or the unguent is squeezed upon it from a collapsible tube; the nurse lifts up the sheet covering the buttocks, the obstetrician raises the upper buttock with his free hand, wipes off the vulvar orifice with pledgets of cotton soaked in a 1 : 2000 sublimate solution, and by the sense of sight inserts the forefinger of the examining hand directly into the gaping vaginal orifice. Nothing is more foolish than the ancient practice of groping about under a sheet for the woman's genitalia, thus dangerously soiling the examining hand which had been made sterile by a pains-

taking disinfection, only to be infected again before its insertion into the vagina. The ability to derive easily all the desired information from a vaginal examination only comes from practice and an education of the tactile sense. It would be well, therefore, for the practitioner, in the beginning of his obstetric experience, to bear in mind a series of questions in their natural sequence, which he desires to have answered, and to persist in his earlier cases until repeated and long-continued examinations have satisfied his mind. Thus : the character of the vaginal discharge ; the state of the perineum, whether relaxed, rigid, or torn perhaps from a previous labor ; the rigidity and distensibility of the vaginal walls and the quantity of secretion upon them,—nature's lubricant ; the capacity of the pelvis ; the condition of the cervix, whether it is rigid or yielding, thickened, edematous, or thinned out ; the degree of dilatation of the os ; the portion of the fetal ellipse which is presenting itself at the os ; the engagement of the presenting part in the pelvis ; the position that the presenting part may have assumed ; the rupture or the integrity of the membranes ; and, if the examination continues during a pain, the effect of the expulsive forces upon the fetal mass. All these are questions of great importance in their bearing upon the diagnosis of the woman's present condition and upon the prognosis as to the character, duration, and termination of the labor.

Having satisfied his mind upon all these points, the obstetrician enters upon the management of labor.

The very first step in the treatment of the first stage of labor should be the evacuation of the rectum. The capacity of a normal pelvis is none too great to permit the passage of the fetal body ; but if the pelvic canal is occupied by a distended rectum full of feces, labor may be delayed, the woman's suffering is materially increased, and the danger of a tear in the greatly distended vagina is considerably augmented. It is only the rectum and sigmoid flexure that need be emptied, and this result is best secured by an enema of a pint of soapsuds with a teaspoonful of turpentine in it. A well-trained nurse will already have done this, perhaps before the doctor's arrival, if she thinks that labor has really begun. The enema acts quickly and effectually, whereas a purgative administered at the beginning of labor, as has been recommended by some obstetricians, begins its action possibly when the os is too much dilated to allow the woman to use a commode. The lower bowel being emptied, the woman, with advantage and comfort to herself, may be allowed to walk about the room or to sit up in a chair, the physician making an examination from time to time to determine the progress of labor and to avoid the serious accident of a precipitate delivery in

the erect posture, an accident dangerous to the mother and usually fatal to the child. This statement leads to the inquiry how often and how long to examine a parturient woman in the first stage of labor, and how long she should be allowed to remain out of bed in a standing or a sitting posture. In a normal case during the first stage of labor, the intervals between the examinations are from two to four hours, or even longer. But two or three examinations need be made during the whole labor. As to the time for putting a woman in labor to bed and keeping her there, it is usual to lay down the rule that as soon as the os has reached the size of a silver dollar the woman should be confined to bed. Many patients might be allowed to be up longer than this, while others with a history of, or conditions predisposing to, quick labors must be put to bed earlier.

Many patients express a desire to go to the water-closet at about this time, but their request can on no account be allowed. Many a woman has discharged her infant into the seat of a water-closet or into the well of a privy, either by design or under the impression that she was having an evacuation of the bowels.[1]

Before the woman is put to bed it should be arranged for the labor in the manner illustrated in figure 216. The mattress is protected by a mackintosh and the bed-sheet is guarded by a pad of nursery cloth.

As the first stage of labor advances, the suffering of the woman increases with each succeeding pain. The alleviation of this pain is naturally demanded by the patient. The dangers and disadvantages that, it is claimed, result from the use of anesthetics in labor are: a prolongation of the process by weakening the uterine contractions and increasing the intervals between them; a disposition to postpartum hemorrhage; an increased liability to sepsis

[1] The resident physician on my service at the Howard Hospital was called to a house in the neighborhood, and fished out of the privy-well, twelve feet deep, an infant which had been immersed in the contents of the well up to its neck for eight hours. The mother had deliberately sat upon the seat until her baby dropped from her. She had then thrown three bricks down upon it. In spite of these disadvantages the child was extracted alive, by means of a pole and some twine. It was received into my wards at the Philadelphia Hospital, where it thrived. On another occasion one of the patients in the University Maternity locked herself in the water-closet, dropped her baby down the bowl, and turned on the water. A nurse's attention was at length attracted to a stream of water running across the floor of the corridor. The water-closet door was broken open, the woman pulled off the seat, and the child, whose head accurately stopped up the exit-pipe of the bowl, was extracted alive, though it had been under water probably five minutes. One of my patients, in the winter of 1907, with a permit to enter the University Hospital, was coming to Philadelphia on the New York express. Between North and West Philadelphia, the train running at least 40 miles an hour, the woman dropped her fetus through the water-closet to the tracks below. It was found more than an hour later by a track-walker lying alive and uninjured on the snow. All cases of this kind do not end so fortunately.

after labor by a relaxation of the uterine muscle, and a subinvolution of the uterus. These objections are ill-founded if the anesthetic is administered in a proper manner. An anesthetic, if not pushed too far, has no influence on the power, duration, or frequency of the pains. By relieving suffering that causes exhaustion the danger of postpartum hemorrhage is avoided.

Fig. 216.—Bed arranged for child-birth. The mattress is protected by a mackintosh, over which a clean sheet is spread. The upper bed-clothes are rolled up at the foot of the bed. The woman's buttocks rest upon a square yard of nursery cloth. The chair is for the obstetrician; at his feet is a waste-bucket, into which the pledgets of cotton used to clean the anus are thrown. The table, in easy reach, has upon it a large basin of sublimate solution, 1 : 2000, in which are many large pledgets of cotton; a small tin cup on an alcohol lamp to boil the scissors for the cord; a half dozen clean towels; a pot of carbolated vaselin; a tumbler of boric-acid solution with squares of clean soft linen in it for the child's eyes and mouth; a tube of sterile silk for the cord.

Subinvolution is never seen as a result of anesthesia, unless it is pushed too far. In some women labor is little more than an inconvenience or a discomfort, and by no means an agony. Women have been known to expel a full-term child when they were hardly conscious that labor had begun.[1] To resort, therefore, to an anesthetic when there is no suffering is obviously absurd. Granting, however, that in many cases anesthesia in labor is an

[1]Dr. B. B. Cates, of Knoxville, tells me of a case in which there was no pain whatever during labor, but at every uterine contraction the patient said she felt as though she had a croquet ball in her mouth (globus hystericus).

advantage, if not a necessity, the physician must select the anesthetic, and must determine when and how he shall use it. The choice lies between ether and chloroform. Cocain, it was thought at one time, would be an efficient local anesthetic, but it proved a failure. Belladonna, applied locally to the cervix, is also useless, although it diminishes rigidity; the same may be said of chloral, taken internally. Repeated hypodermatic injections of hydrobromate of hyoscin, gr. $\frac{1}{150}$ (scopolamin), and morphin, gr. $\frac{1}{6}$, are sometimes useful, but do not compare in efficiency with ether or chloroform.[1] After a personal trial of this anesthetic I have given it up. There is a tendency to prolongation of labor, to postpartum hemorrhage, and to asphyxia of the infant if the woman is brought deeply enough under its influence to relieve her pain. Morphin alone is occasionally indicated, but it usually delays labor. Spinal anesthesia by the injection of cocain solution into the lumbar spine, while enthusiastically tried for a time, deserves no consideration in the management of an ordinary case.[2] The proposition of Stoeckel[3] to utilize Cathelin's procedure is more reasonable. A solution of novocain 0.15, suprarenin 0.000325 in 33 c.c. normal salt solution, is injected in the sacral canal through the sacral hiatus at the end of the bone. The method is receiving a trial in the University maternity. The choice in the eastern seaboard of the United States will usually be ether. Chloroform is in disfavor in this part of the world, although, perhaps, unjustly. Ether is an efficient, convenient, and satisfactory agent in obstetrical practice, except, of course, in the treatment of eclampsia. There are, however, two precautions to be observed in its administration—not to give it too long and not to give too much of it. The first error is avoided by beginning its administration as late in labor as possible; it is better to put off the resort to an anesthetic until the second stage of labor, when the suffering in the first stage is not too great. One avoids giving too much: (1) By using a light towel thrown over the face and dropping only a few drops at a time, just below the tip of the nose, at the end of an expiration, so that the whole vapor is sucked into the lungs with the succeeding inspiration; (2) by only beginning

[1] "Schmerzverminderung und Narkose in der Geburtshülfe mit spezieller Berücksichtigung der Kombinierten Skopolamin Morphium Anæsthesie," Steinbüchel, Leipzic u. Wien, 1903. Franklin S. Newell, "Anesthesia in the First Stage of Labor," "Jour. of Surg., Gyn., and Obstet.," July, 1906. Gauss, Hocheisen, and Lehman report their results in 670 cases. "Med. Klinik." No. 6, 1906. "Muench. Med. Wochenschr.," No. 37, 1906. "Ztsch. f. Geb. u. Gyn.," Bd. lviii, p. 297.

[2] "Medullary Narcosis," W. L. Rodman, "Therapeutic Gazette," Jan. 15, 1901; good description of technique "Transactions of Southern Surgical and Gynecol. Assoc. for 1900," "Year-Book of Medicine and Surgery," 1901–1902, "La Presse Medicale," Nov. 9, 1901, No. 9.

[3] Zentralbl. f. Gyn., No. 1, 1909.

the administration of ether as the pains come on, and discontinuing it between them; and (3) by endeavoring to produce not complete anesthesia, but only analgesia.

As labor advances and the first stage is about to pass into the second, one should expect the rupture of the membranes and the escape of liquor amnii. Provision must be made for the sudden escape, often rather startling to the patient or to an inexperienced practitioner, of a pint or more of liquor amnii, which must be caught in some clean towels or mopped up by sterile absorbent cotton.

If the membranes fail to rupture at the end of the first or at the beginning of the second stage of labor, the physician must consider whether he shall artificially break the bag of waters. In the case of a primipara such interference is not justifiable. The bag of waters is a perfect hydrostatic dilator, acting without great force, and in primiparæ a slow, gradual, and conservative dilatation of the maternal soft parts is most desirable, to avoid lacerations of the cervix, vagina, or perineum. In multiparæ the artificial rupture of the membranes is admissible after the completion of the first stage of labor; the interference certainly hastens the expulsion of the child, and as the soft parts of a woman who has already borne children are distensible there is not the same necessity for care to preserve nature's conservative dilator. Under no circumstances, in an ordinary uncomplicated labor, should the membranes be ruptured before the full dilatation of the os. Any one who has observed what in the nurse's parlance is called a dry labor—that is, one in which the membranes rupture early—will not dispute this assertion. Occasionally, even in primiparæ, the first intimation that a woman receives of the beginning labor is the escape of the liquor amnii, the membranes having ruptured before the os is at all dilated. In these cases the labor is longer, the woman's suffering is much greater, and the likelihood of damage to the maternal tissues is very considerably increased. If the membranes are artificially ruptured during the second stage of labor in a multipara, the following rules must be observed: In the first place, the membranes are not to be ruptured during a pain, for the sudden gush of liquor amnii might carry with it a loop of the cord. It must be clearly established that the tissues to be punctured are the membranes, and not the child's scalp or the distended lower uterine segment. It is often possible to hook the finger-tip into a fold of the membranes and to tear them by pulling outward. They may also be pinched through between the forefinger and the thumb or middle finger. If these manual methods do not succeed, the Emmet curette forceps may be used to pinch and tear a fold of the membranes.

During the second stage of labor a new and important element enters into its mechanism—the powerful action of the abdominal walls. Indeed, it has been claimed that the contraction of the abdominal muscles is the principal, the uterine force the secondary, expulsive power in this stage of labor. By the employment of a "puller" which fixes the chest above and the pelvis below, the power of the abdominal muscles may be utilized to its utmost extent. This is done by fixing the feet, protected by a pillow, against the foot-board of the bed, and attaching to one corner of it a rope or a twisted sheet on which the woman can pull with her hands.

The straining accompanying the uterine action, denoting that the second stage of labor has begun and that the presenting part is descending into the birth-canal, lasts in the typically normal case about an hour and a half or two hours, when, if the physician observes the genitalia,—and the period of labor has arrived when it is desirable actually to observe the process,—he notices that the anus is opened and the rectal mucous membrane is exposed to view; with every pain small masses of feces are extruded from the anus which must be wiped away always toward the coccyx with large pledgets of cotton soaked in sublimate solution; the perineum bulges outward, and the vulvar orifice opens a little, disclosing a small portion of the child's scalp. With every pain the perineum becomes more distended, the vulva gapes more widely, until, finally, the perineum, by the tremendous tension to which it is subjected, becomes almost as thin as paper, and it seems a physical impossibility for the head to escape through the vulva without tearing the overstretched tissues that form the pelvic floor. In fact, frequently the fetal head does make a way for itself through the perineum, instead of over and in front of it as nature intended, and after labor there is found a more or less extensive laceration of the pelvic floor. Schroeder's statistics show that in primiparæ the fourchet, the little fold of skin at the posterior commissure of the vulva, is torn through in 61 per cent., while in 34 per cent. of all primiparæ and in 9 per cent. of multiparæ the perineum is more or less lacerated. If the patient is placed upon an examining or operating table a few days after labor and a careful examination is made of the genital canal, the proportion of lacerations in the anterior and posterior vaginal walls involving the underlying muscle will be found at least twice as great as Schroeder's statistics indicate. The problem presents itself, therefore, to every obstetrician in every case to avoid these accidents if possible. Although the management of a perfectly normal labor is here considered, so frequent an accident is laceration of the

birth canal, and so constant is the danger of it, that it is necessary to take up, in this connection, the study of its causes, in order to devise an effective preventive treatment. The causes of laceration of the pelvic floor may be divided under three heads: (1) A relative disproportion in size between the outlet of the birth-canal and any part of the fetus, which makes the escape of the latter a physical impossibility unless the aperture is enlarged by tearing its least resisting border; (2) such a rapid expulsion of any part of the fetal body that the maternal tissues can not gradually dilate, but give way before the sudden strain imposed on them; and (3) any abnormality in the mechanism of labor which pushes the presenting part backward against the center of the perineum and prevents its propulsion forward under the symphysis pubis. In the first category, relative disproportion, might be put those cases in which the head is too large or the vulva too small; and, further, those cases in which the head presents its largest instead of its smallest diameters, as happens in insufficient flexion in vertex presentations. Under the second heading, precipitate expulsion, might be put all cases in which the expulsive forces are too strong; cases of straight sacrum, in which the fetal head is shot through the pelvic canal and suddenly puts great strain on the perineum; cases in which too powerful traction is made with the forceps. Under the third head, an abnormal backward direction of the presenting part, might be placed those cases in which a pelvis of a male type, with approximated pubic rami, pushes the head backward and throws a greater strain on the perineum; cases again, in which the woman, just as the head is passing through the vulva, suddenly straightens her legs and brings them close together; further, cases in which a straight sacrum allows the head to descend directly upon the perineum instead of directing it forward toward the vulvar opening, as a normally curved sacrum should do; and, finally, cases in which overflexion brings the vertex to bear directly upon the center of the perineum.

It must appear, from these many different causes, that the preventive treatment of laceration of the perineum differs considerably in order to meet the diverse conditions that threaten the integrity of the pelvic floor; thus, if there is a very great relative disproportion between the head and the vulva and the opening *must* be artificially enlarged, instead of allowing the perineum to tear, perhaps into the rectum, it is better to nick the margin of the vulva on the side, and allow the tear to occur where it can not extend too far, and can do no harm. This simple operation is called *episiotomy*. It should be distinctly

understood that it is called for only in rare and exceptional cases. Personally, I have no confidence in it whatever, as I believe it to be based upon an incorrect idea as to the mechanism of pelvic tears. After the delivery of the child and the placenta the small wound is to be closed by catgut or silkworm-gut sutures. If the danger to the perineum comes from a precipitate expulsion of the head, the proper preventive treatment is a retardation of labor, either by holding the advancing head back with the hand or with the forceps, or by giving an anesthetic to control the voluntary muscles. Faulty mechanism, as over-flexion or extension, may be corrected by the forceps. It is evident, therefore, that no single plan of preventive treatment, no inflexible method of "supporting the perineum," as it is called, will avail in all cases.

There is, however, a routine practice directed against the commonest cause of "lacerated perineum" that may prevent a laceration, or at least a very extensive tear extending into the rectum. There are excuses for the lesser grades of laceration, and it is true that no physician, be his skill what it may, can absolutely avoid this accident; but a complete destruction of the perineum, a tear through the rectum, is rarely justifiable. It is most frequently the result of some blunder, carelessness, or error of technic.

As the head distends the vulva almost to the utmost, it fails to recede as it has done after the previous pain, but remains in view until the next uterine contraction, which, with the abdominal contraction that accompanies it, suddenly expels the head through the widely stretched external outlet. The expulsive force acting suddenly and being much greater than is necessary to overcome the slight resistance now offered by the soft parts, lacerates the tissues instead of dilating and stretching them. This being the most frequent cause of lacerated perineum, it is easy to devise a means to meet and overcome the difficulty. The main requirement is to regulate the expulsive force so that it is just sufficient to overcome the slight resistance offered by the distended perineum, and as an auxiliary measure to restrain the progress of the head should this force become too great or be exerted too suddenly. It is obvious that one can not govern the force of the uterine contractions, which are involuntary; but one can regulate the force and duration of the abdominal contractions by appealing to the woman's will. Thus, the physician can call upon her to strain forcibly or gently, as the case may require, bringing into more or less active play the expulsive action of the abdominal walls; he can command her to stop straining, or to open her mouth and breathe rapidly, which amounts to the same thing,

thus inhibiting the greater part of the expulsive force; or, if a powerful uterine contraction should come on, or if the woman should exert her voluntary muscles too violently, or should fail to obey the command to stop straining, the expulsive forces may be neutralized simply by making such firm pressure against the child's head with the hand that it will not budge. At the same time the outspread hand, which can most conveniently be used for the purpose, is applied to the distended perineum so that the thumb and forefinger encircle the posterior commissure of the vulva. This hand helps to flex the head when the occiput is anterior; it restrains the progress of the head, and it pushes it forward under the arch of the pubes, away from the overstretched muscles of the pelvic floor. This is the best plan of supporting the perineum, as it is called, though it is not really a support of the perineum at all, but a diminution of the expulsive forces and a regulation of the progress of the fetal head, which is supported, restrained, and directed by pressure, partly through the perineum, partly directly upon the head itself.[1]

Presuming that these precautions have been successful, that the perineum has been safely retracted over the child's head, and that the head is born, the face at first appears white, but almost immediately turns quite purple and looks as if the child must be choking to death. It is, as a rule, however, in no serious danger. The head being the only part of the fetal body free from pressure the blood is determined to it, and is prevented from returning freely by the pressure about the neck, thus giving the child's head, as it protrudes from the vagina, a most alarming appearance of deep asphyxia. There is, however, in some cases, a more serious element in the asphyxiated look of the child; in one out of four labors the cord is found coiled about the child's neck, usually only once, and that lightly, but occasionally many times, nine coils having been recorded in one case, and so tightly occasionally as to completely strangulate the infant, not by pressure upon the neck, but upon the cord. This anomaly occurring so frequently, and having such serious results, must always be borne in mind, and as soon as the head is born and the neck becomes accessible the medical attendant must at once ascertain whether the cord encircles it or not, by sweeping a forefinger between the child's neck and the maternal symphysis.

If the cord is found in this situation, it should be gently

[1] Sarwey in "Winckel's Handbuch" (vol. i², 1904) gives some fifteen different methods of supporting the perineum. There is no one of them that insures the woman against injury. The plan advocated by the author is a modified Ritgen manœuvre, the physician seated alongside the bed facing the woman's vulva, and the patient lying upon her side.

pulled upon, and whichever portion yields should be drawn out, so enlarging the loop that it may be slipped over the head; or, if that is impossible, making the loop at least large enough

Fig. 217.—Retarding the escape of the head and pushing it away from the perineum. The patient is on her left side. The physician sits alongside the edge of the bed, facing the vulva. The woman's knees are held apart by a pillow between them.

to allow the shoulders to pass through; or if that, again, is not feasible, if the cord so firmly constricts the child's neck that the loop or loops can not be loosened, it may be hastily ligatured with a double thread and then cut between the ligatures. The child, in such a case, must, of course, be extracted immediately, else it will be fatally asphyxiated.

The cord not being felt, or having been attended to, if found around the neck, the physician next turns his attention to the child's head. The head is protruding from the vulva, the face is swollen and almost purple, looking as if the only hope for the fetus lay in speedy delivery; the labor is almost concluded, the medical attendant sees his anxiety and attendance almost at an end, and for all these reasons, especially if he is inexperienced, he feels strongly impelled to terminate a process that seems to endanger the fetus, that has caused his patient much suffering, and himself, perhaps, fatigue, by pulling on the head and rapidly extracting the fetal body. If he does so, however, the shoulders hastily pulled through the vulva will almost

surely lacerate the perineum, perhaps deeply. Many a case of lacerated perineum, even into the rectum, is explained in this way. A still more serious consideration is that immoderate traction upon the head may seriously injure the child's spine and the spinal column. As experience has shown that the fetus is not subjected to great danger in this situation, and as premature efforts to extract it entail upon both woman and child a danger more imminent than that which it is endeavored to avert, it is better to do nothing at this stage of labor but simply to support the head upon the hand, waiting for the action of the natural expulsive forces, which will rotate the shoulders, and with them the head, and shortly after expel the rest of the body. While the child's head protrudes from the vulva the opportunity should be taken to cleanse the eyelids with squares of clean soft linen, soaked in boric acid solution, gr. x to ℥j of distilled water, and to inject this solution into the eyes with a pipet. After waiting a minute or two, the physician may stimulate the uterus by rubbing or kneading it, and may assist its contractions by pressure upon the abdominal walls over the fundus. This is all the assistance required in a normal case. With this slight addition to the natural forces the shoulders descend and rotate; the anterior shoulder slips out first under the symphysis pubis, the posterior shoulder and arm quickly follow, the anterior arm then emerges, and, the shoulders being born, the rest of the body is immediately expelled so rapidly that it is difficult to follow the mechanism. It is admissible, if one is careful not to use too much force, to pull the child's head backward to facilitate the birth of the anterior shoulder, forward to assist the birth of the posterior shoulder (Figs. 218 and 219). Indeed, it is an advantage to do so, if traction is not made too soon or too forcibly. The moment the child escapes from the birth-canal it emits a lusty cry, which is usually synchronous with a sigh of intense satisfaction from the mother, who has in an instant been entirely relieved of long and intense suffering. There are now two patients on the physician's hands at once, and, although he must in practice devote his attention to both equally and at the same time, it is more convenient here to consider their management separately. Although the child's expulsion from the mother gives her such immense relief, it by no means terminates the labor nor brings her an immunity from all danger; indeed, the chief, the most common danger of parturition, hemorrhage, may be said to begin with the expulsion of the child, and sometimes a most difficult and dangerous complication of labor, adhesion of the placenta to the uterine wall, only manifests itself after the complete escape of the child from the birth-canal. There are, therefore, two problems with which to deal in the third stage of labor in almost every

case, no matter how normal it may appear,—the delivery of the placenta and the prevention of hemorrhage. As hemorrhage may occur before the expulsion of the placenta, and therefore stands first in point of time; as this accident is of the gravest nature and its prevention of the greatest importance, the first thought of the

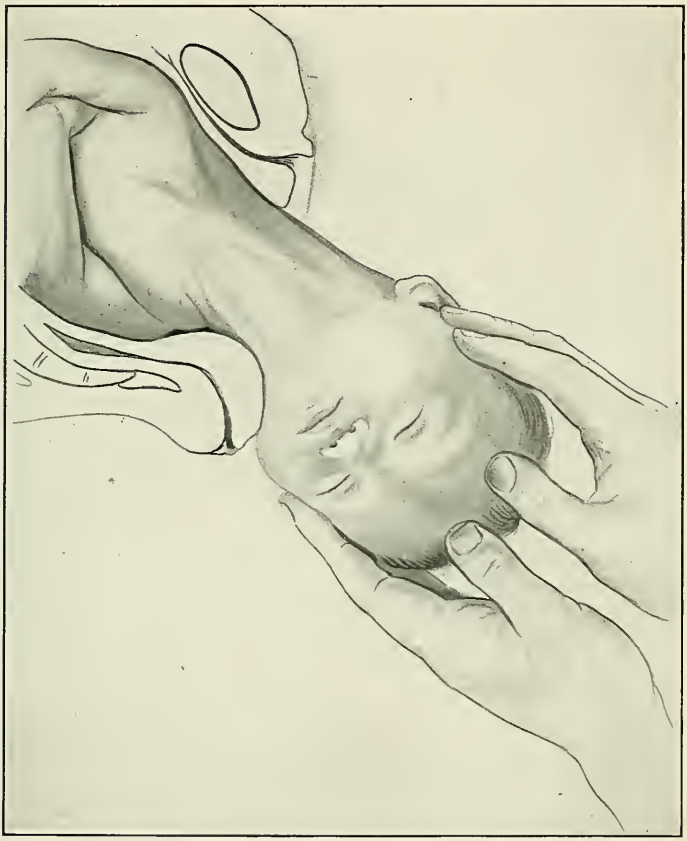


Fig. 218.—Pulling the infant's head toward the maternal sacrum to facilitate the escape of the anterior shoulder (Bumm).

medical attendant should be the routine means to adopt in every case to prevent its occurrence.

Provided the uterus contracts and remains contracted, the enormous blood-vessels in its walls are obliterated and hemorrhage is impossible. On the other hand, if the uterus remains flaccid and uncontracted while the placenta is being separated, or if the organ, at first contracted, afterward relaxes, hemorrhage of the most alarming character must as necessarily occur.

The whole problem, therefore, of preventing hemorrhage after delivery resolves itself into a problem of securing and of maintaining uterine contraction.

Firm Contraction of the Uterus After Labor is Secured by External and by Internal Stimuli to Contraction.—The internal stimulus consists of a dram dose of the fluid extract of ergot in a little water, administered as soon as the child's body is born. It has been claimed that ergot should never be administered before

Fig. 219.—Pulling the infant's head toward the maternal symphysis to extract the posterior shoulder (Bumm).

the expulsion of the placenta for fear of hour-glass contraction of the uterus. But it requires at least fifteen minutes after ergot is administered by the mouth before its action is felt by the uterus; meanwhile, in a normal case the placenta is expressed and the influence of the ergot is felt at the time it is most needed, as a rule, just after the conclusion of the third stage of labor. The external stimulus consists of manipulation of the uterus. Luckily the uterine muscle is irritable, and shows its irritation by contracting its fibers. Luckily, again, it is accessible. One can easily grasp it through the abdominal walls; can rub it and exert direct pressure upon it, these actions exercising a powerful irritant influence upon the uterus and bringing about, in the ordinary case,

firm contraction. This is the most efficient, readily applied external stimulus to uterine contraction, and one that must be invariably applied, and that, too, continuously from the moment the infant's body is expelled until a milder form of external stimulus which is to maintain uterine contraction is adjusted,—the obstetrical binder. The moment that the child escapes from the woman's body the physician or nurse seizes the uterus through the abdominal wall and exerts constant pressure upon it, irritating it still more from time to time by a kneading or a rubbing motion. If the woman is fortunate enough to have a good nurse, this duty may safely be left to her, while the doctor washes his hands and takes a brief rest. Some fifteen minutes having elapsed, the placenta being delivered, the woman having been cleaned and made more comfortable, the constant pressing and kneading of the uterus may be replaced by the more gentle and more continuous external stimulus of the *binder* and abdominal pad. The binder holds an important place in the treatment of English-speaking women. In some civilized countries it is not used at all, and, it must be confessed, it is unnecessary, from the medical point of view, after the first twenty-four hours.

The obstetrical binder, however, adds greatly to the woman's comfort by maintaining the intra-abdominal pressure and thus preventing cerebral anemia. It undoubtedly preserves the figure, —a fact to which no woman is indifferent,—it diminishes the risk of permanent diastasis of the recti muscles,[1] and it lessens the danger of postpartum hemorrhage by maintaining a tonic contraction of the uterus. For all these reasons the use of the obstetrical binder is well justified—is, in fact, demanded—in the intelligent management of the puerpera. The best binder is a piece of unbleached muslin, about a yard and a quarter long and wide enough to reach from the trochanters to the floating ribs. It is pinned together from above downward, and is made to fit more snugly and comfortably by making gores at the sides above and below the hips. The pad should consist of one or two folded towels *put above the navel* to fill the hollow in the epigastrium left by the evacuation of the womb and its reduction in size.

The second problem of the two that confront a physician in the management of the woman in the last stage of labor is the delivery of the placenta. To superintend this process intelligently it is necessary to recall the chief phenomena of the mechanism of the third stage of labor.

The placental structure resembles a sponge, and as the uterine

[1] For a period of about six months I omitted the binder at the request of Dr. Stanton, who was studying blood-pressure in the puerperæ of the University Hospital. During that winter I was obliged to operate on more cases of diastasis of the recti muscles than I would normally do in two or three years.

wall contracts and retracts, the placenta follows the reduction in the size of the placental site by a corresponding reduction in the *placental area, up to a certain point.* The placenta diminishes in size until all its villi come in actual contact with one another; until, instead of being a spongy organ with the intervillous blood-spaces separating the villi from one another, the whole organ becomes a solid mass, and can not accompany a further reduction in the area of uterine wall to which it is attached, so that the smallest additional contraction of the uterine muscle *must* spring off the whole placental mass at once. This point is reached when the placenta has been reduced to about one-half of its natural area—a fact that has been demonstrated in uteri removed by the Porro Cesarean section or in postmortem examinations of patients who had died during or directly after labor. The expulsion of the placenta after its detachment is easily understood; lying in the uterine cavity as a loose foreign body, all that is required is the vigorous action of the uterine muscle to drive it out. But, once beyond the province of the thick, muscular portion of the uterus, above the contraction-ring, there is no further force to expel the placenta, for it lies in the semiparalyzed lower uterine segment (see Fig. 220), cervix or vagina, where it may remain for hours or days, until it undergoes decomposition.[1] As the lower animals never require an artificial delivery of the after-birth, many obstetricians of the eighteenth century argued that the delivery of the placenta should be left entirely to nature. The result was disastrous, as may be imagined.

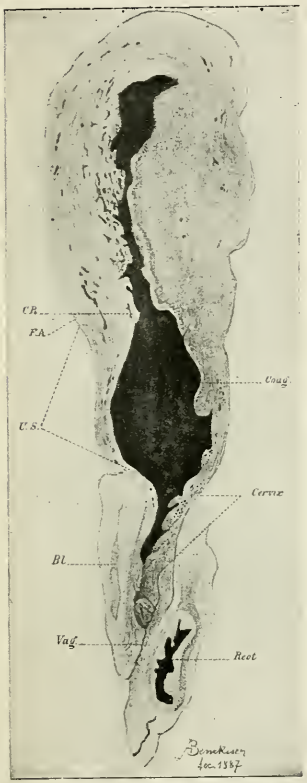


Fig. 220.—Dilated lower uterine segment and cervix after labor, from a frozen section (Benckiser and Hofmeier).

It is, therefore, a necessary part of the management of the third stage of labor to secure the separation of the placenta by stimulating the uterus to contract and by aiding it to expel

[1] V. Campe ("Zeit. f. Geburtsh. u. Gyn.," Bd. x, H. 2) in 120 observations found that in 24 instances the placenta had not been expelled in twelve hours.

its contents by exaggerating its expulsive power. These two objects are best obtained by what is known as Credé's method, a method first proposed to the profession in a systematic manner by the late Professor Credé, of Leipsic,[1] in 1861. A similar plan had been in use in Dublin for a long time before, and many primitive and savage people have employed, perhaps for ages, methods based upon the same principle.

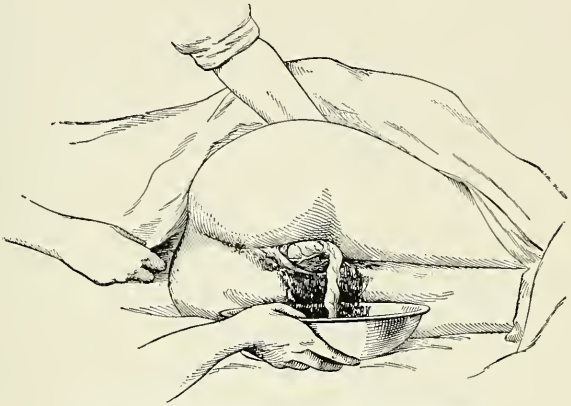


Fig. 221.—The expression of the placenta.

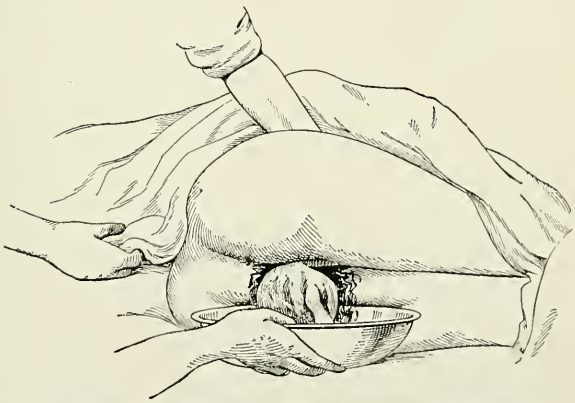


Fig. 222.—The reception of the placenta in a basin.

In applying Credé's method the uterus is seized in a grasp illustrated in figure 311, is kneaded and rubbed until it contracts with vigor; only then, and only in conjunction with the uterine contraction, should it be firmly pressed down in the direction of the axis of the pelvic inlet, while it is compressed

[1] "Monats. f. Geburtskunde," xvii, p. 274.

between the fingers and thumb with considerable force. The placenta is squeezed out as the stone is pressed out of a cherry. It should be expressed twelve or fifteen minutes after the child is born, as complete separation has not occurred in the average case till this time has elapsed. As it slowly emerges from the vulva it should be caught in the obstetrician's hand, while a nurse holds a basin pressed close into the mother's lower buttock, to receive the blood that usually spurts out with the after-birth. The membranes trail after the placenta, running up into the vagina and the uterine cavity. To extract them without tearing them, and thus leaving a portion behind, they should be seized between the whole length of the thumb and forefinger and gently pulled, first forward toward the symphysis, then backward toward the sacrum, the uterus meanwhile being allowed to relax. It is a mistake to turn the placenta over several times to make a "rope" of the membranes.

To return to the infant. The head and shoulders having escaped, the rest of the body slips out almost immediately, the child's arrival being announced usually by a vigorous cry, a purely reflex action caused by the sudden shock which the new-born experiences on suddenly emerging from an aquatic existence, in which its immediate surroundings have a temperature of about 99°, into the atmosphere and a temperature not over 70°. This violent shock produces not only a spasmodic action of the diaphragm and the muscles of respiration, but also of the bladder, and of all of the muscles of the body as well, so that often urine is voided directly after birth, and the arms and legs are moved about quite violently. As soon as the child is born, it is well to see that its air-passages are clear and not clogged by mucus or blood that might have been inspired during labor. This is done by crooking the little finger and introducing it back of the epiglottis; if, however, the child at once emits a vigorous cry, it is proof enough that the respiratory tract is not obstructed. The infant is then placed on its right side, this posture favoring the closure of the foramen ovale and facilitating the passage of the blood from the ascending cava over the Eustachian valve into the right auricle. The position should also be so arranged as to turn the child's face from the mother's genitals and to protect the infant's air-passages from the maternal discharges incident to the third stage of labor, care being taken, also, not to put the cord too much on the stretch, for all this time, of course, the infant remains attached to the mother by the umbilical cord. Now arises the question, in every case, as to the advisability of severing the cord at once and getting the child out of the way. The placenta, it has been argued, no longer performs its vital functions; the child breathes,

and, therefore, it might be better to cut the cord, to remove the infant from the bed, and to turn it over to the nurse. This plan, however, does not take into account the fact that there remains a considerable quantity of fetal blood in the placenta; that it is an advantage to have all of this blood, if possible, returned to the infantile body where it belongs, and that, further, the depletion of the placenta renders its expulsion easier. The blood in the placenta will return to the child's body, if time is allowed for it; on the one hand, the action of the respiratory muscle exerts a suction upon the placental vessels, which aspirates the blood from the placenta; on the other hand, the pressure upon the placenta by the uterus drives the placental blood into the fetal body. To demonstrate the advantage of late ligation of the cord, Budin [1] conducted a series of experiments, with the following results: the cord ceased beating in 22 cases, on the

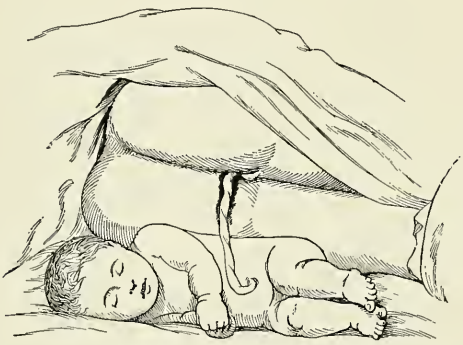


Fig. 223.—The position in which the child should be placed after birth.

average, in two and one-half minutes. In these cases the average weight of the placenta was 520 gm. (1$\frac{1}{7}$ lb.), and the amount of blood that escaped from the umbilical vein in 20 cases was 92 gm. (3.2 oz. Avoir.) less in late than after immediate section of the cord.

Thus, by immediate ligation 92 gm. (3.2 oz. Avoir.) of blood are lost to the infant's body. Moreover, in contrasting the weights of children after immediate and late ligation of the cord there was a gain of two to three ounces in favor of late ligation. It is better, therefore, to wait two or three minutes after the birth of the infant before cutting its cord.[2] The proper time having arrived, the cord should be ligated about two fingers' breadth from the child's

[1] Publications du "Progrès Médical," 1876; also "Obstetrique et Gynecologie," 1886.

[2] There has been some criticism of Budin's proposition to ligate the cord late; several German authors have attributed a number of infantile complications to it, but the objections to the plan are ill founded.

body with a piece of stout surgeon's silk or narrow bobbin, sterilized. The ligature is tied firmly once around with a double knot. The ends are then doubled around again and are tied with a single and a bow knot, so that the nurse, after the child is washed, may slip this last knot and may then retie the ligature firmly. This precaution surely avoids a primary or secondary hemorrhage from the cord, which sometimes occurs in consequence of a shrinkage of the mucous tissue, making the original ligature too loose. The obstetrician is now ready to cut the cord. The child is slippery and hard to hold; its legs and arms are jerked about in a very disconcerting manner to the beginner, so that carelessness in the use of scissors at this juncture might result in injury to the

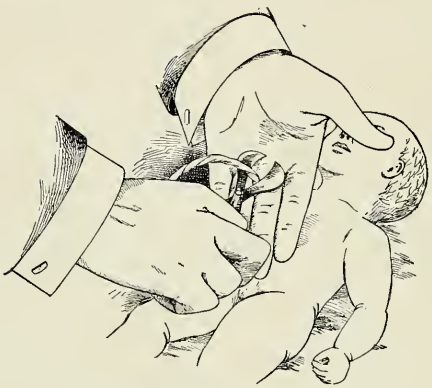


Fig. 224.—Cutting the cord.

fingers, the toes, or, in the male child, to the penis. The manner of cutting the cord illustrated in figure 224 surely avoids all such accidents. The child's connection with its mother being severed, it is wrapped in a blanket ready to receive it and is put in some safe place, where it will not be trodden nor sat upon. Its own crib is the best place for it. The cut end of the cord attached to the placenta is not tied, but is allowed to drain into a basin, so as to lessen as much as possible the bulk of the placenta. In case of twins, however, a double ligature on the cord is required, else the second child might bleed to death on account of anastomosis between the vessels of the placenta.

CHAPTER II.

The Puerperal State.

THE moment that labor terminates with the expulsion of the placenta, there begins an effort on the part of nature to restore to their normal condition the organs and systems that have been in an active state of development for nine months before; there is destroyed in a few weeks what it has taken months to build up, and with this destructive process goes on with equal rapidity one of growth and repair. There is a reduction of the sexual, the circulatory, and the nervous systems to their normal capacities and functions by the destruction of redundant material; at the same time there is a repair of the injuries of child-birth, the formation of a new endometrium, and the rapid development of an entirely new and complicated function, lactation. And yet, by a provision of nature which is almost beyond comprehension, these two opposed processes of decay and regeneration go on at the same time in one body, involving whole systems and organs, without manifesting themselves in the slightest derangement of the individual's health. Under no other circumstances could an organ weighing two pounds, and as large as the liver, degenerate and in great part disappear without the gravest symptoms of constitutional disorder. In no other condition could the whole composition of the blood be materially altered; the heart changed in size, power, and capacity; the nervous system modified in sensibility; a large body-cavity, stripped of its mucous membrane and again resupplied with a new lining; large organs, as the breasts, suddenly assuming great functional activity, without very marked evidence of disease; and yet in the puerperal state there are all these remarkable changes while the woman in appetite, feeling, and temperature is in perfect health. But it is obvious that in a condition which, though it is called physiological, borders so closely on the pathological, very little is required to pass the boundary-line into disease. Anomalies of excess and deficiency in the natural processes are common; the raw surface of the uterus with the wounds of the vagina and vulva give ready entrance to infectious bacteria and their toxins, and the whole individual seems especially sensitive to unfavorable external influences, both mental and physical. Consequently this is the period in the history of the child-bearing woman that is most beset with difficulties and dangers and most likely to be marked by accidents and complications. The pre-

ventive and curative treatment of these complications is one of the most difficult tasks in obstetrics, and success here, as elsewhere in medicine, depends to a great extent upon a thorough knowledge of the natural processes.

The puerperal state, or the puerperium, comprises the time from the termination of labor until the uterus has regained its natural size. This is a period, in the normal case, of *six weeks.*[1]

The study of the physiological phenomena in the puerperium, or puerperal state, involves a study of the reduction of the uterus directly after delivery to the uterus of the healthy non-pregnant woman,—a process called technically "the involution of the uterus"; it involves a study of the involution of the vagina, of the destruction of the deciduous mucous membrane, and the regeneration of the endometrium; of the retrograde changes that occur in the uterine ligaments and peritoneal covering and in the ovaries; of the alterations by which the blood and the heart regain their normal condition and of the changes in the pulse; of the changes in the body-weight, the temperature, the skin; the action of the bladder and of the alimentary canal. An important factor also in the puerperium is the establishment of the milk secretion.

The Involution of the Uterus.—Three theories have been advanced to account for it: (1) A fatty degeneration of the muscle-fibers and the absorption of the fine granular fat-globules to the complete destruction of the uterine muscle, its place being taken by a new growth of muscle-fibers developed from the embryonal muscle-cells in the outer layers of the myometrium. (2) A partial degeneration and an atrophy of the large muscle-fibers seen in a pregnant uterus at term. (3) The conversion of the muscle-cell contents into a peptone, its absorption into the blood-current and discharge through the kidneys, giving rise to the peptonuria of puerperal women (Fischel).

Kilian,[2] in his examination of rabbits' uteri thirty to thirty-six hours after they had expelled their young, found fat-globules in the epithelial covering of the uterus, noticed that the muscle-fibers looked fainter and paler than in pregnancy, and saw in their interior very fine, shining fat-globules; alongside of these degenerated muscle-fibers Kilian found some quite young fibers, as he had seen them in the uteri of young animals. Heschl[3]

[1] The word puerperium comes from *puer*, a child, and *pario*, to bear, and denoted, in the original Latin, the child-bed period, the lying-in period; so it is an appropriate term to designate this one of the four periods in obstetrics,—pregnancy, labor, the puerperium, and lactation.

[2] "Die Structur des Uterus bei Thieren," Henle u. Pfeuffer's "Zeits. f. rationelle Medicin," 1849 u. 1850, Bd. viii, u. ix.

[3] "Untersuchungen über das Verhalten des menschlichen Uterus nach der Geburt.," "Zeits. der k. k. Gesellschaft der Aerzte in Wien," 1852, viii, 2.

confirmed Kilian's observations, and went even further in declaring that the muscle-cells were completely destroyed by fatty degeneration; this writer saw, in the outer portion of the uterine body, at first nuclei; which, developing cell-contents around them, gradually transformed themselves into typical unstriped muscle-fibers. Thus, after labor the uterine muscle was destroyed and a new development of muscle-tissue occurred to take its place. Robin [1] claimed that the involution of the uterine muscle

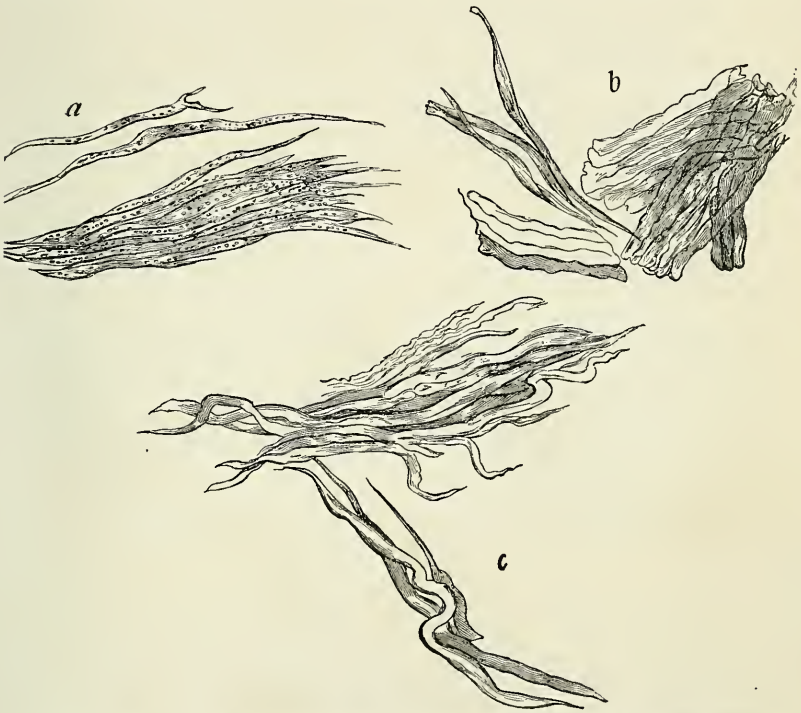


Fig. 225.—*a*, Uterine muscle-fibers nine days postpartum; *b*, uterine muscle-fibers eight days postpartum; *c*, uterine muscle-fibers in the eighth month of pregnancy.

is essentially an atrophy of the individual muscle-cells. Kölliker [2] says that the involution of the puerperal uterus consists of a diminution in the size of the contractile fibers in the muscle-layer and a fatty degeneration. Mayor,[3] from a study of fourteen specimens dating from the first day after delivery until the ninth

[1] "Dict. encycl. des Sc. méd.," 2e serie, t. x, p. 14.

[2] "Gewebelehre," 5. Aufl., p. 565.

[3] "Etude histologique sur l'Involution utérine," "Archives de Physiol. norm. et path.," ix, x, 1887, p. 560.

month of lactation, concludes that the fatty degeneration of the muscle-fibers is more pronounced than Robin thought, but not as complete as Heschl believed; it does not seem to cause the destruction of the muscular elements. Mayor, therefore, attributes to atrophy the chief rôle in the involution of the uterus. Winckel [1] holds that the reduction of the puerperal uterus is due to fatty degeneration. Sänger,[2] from the observation of twelve uteri obtained from four hours to fifty-five days after labor, recognizes the fatty degeneration in the muscle-cells, but does not believe that they are destroyed.[3] Microscopic sections of five uteri in my possession, obtained respectively in the last week of pregnancy, two hours, thirty-six hours, seventy-two hours, and seven days after labor, indicate that fatty degeneration plays a most important part in the reduction of the large muscle-cells characteristic of pregnancy to the much

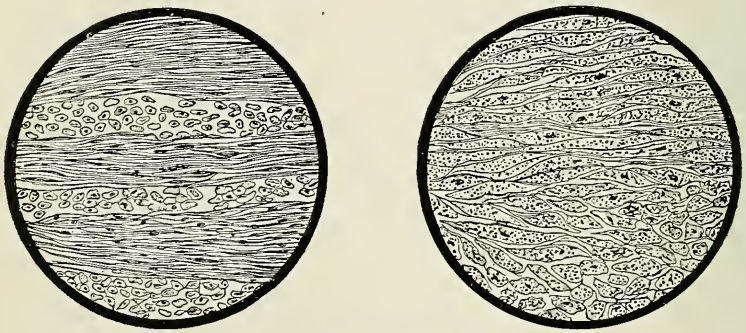


Fig. 226.—Muscular tissue of the pregnant and of the puerperal uterus.

smaller muscular fibers of the unimpregnated uterus. My own belief is that the redundant material within each cell is destroyed by some degenerative process (chiefly fatty), but that the cell is not destroyed *in toto*. Measurements made by Sänger [4] show plainly that the reduction of the uterus after labor is effected by a diminution in the size of the individual fibers, and not by their destruction.[5]

[1] "Lehrbuch der Geburtshülfe," 1889.

[2] Abst. in Schmidt's "Jahrbücher," No. 3, 1888, p. 250.

[3] Sänger says that "the fat-globules and other degeneration products do not enter, as such, into the circulation, but are oxidized on the spot. There is no such thing as a puerperal lipemia" ("Die Rückbildung der Muscularis der puerperalen Uterus").

[4] *Loc. cit.*

[5]

Fiber-length	in pregnant uterus	208.7 μ.
"	" in first few hours postpartum	158.3 μ.
"	" until the fourth day postpartum	117.4 μ.
"	" in first half of second week postpartum	82.7 μ.
"	" in beginning of third week postpartum	32.7 μ.
"	" at end of fifth week postpartum	24.4 μ.

The shrinkage of the uterus in the process of involution is expressed by the following average measurements: Height of fundus above symphysis, directly after labor, 10.9 cm.; on the first day the fundus rises to 13.5 cm.; on the eighth day it has sunk to 7.3 cm. The breadth of the fundus at the tubal insertions is 11 cm. directly after labor; 12.2 cm. on the first day; 8.1 cm. on the eighth day. The uterine cavity measures 14.8 cm. on the first day; 10 cm. by the fourteenth day.

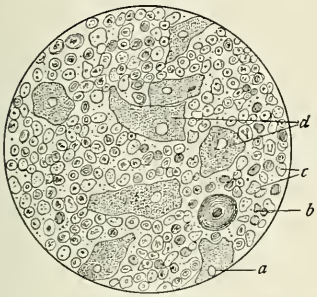


Fig. 227.—Lochia on the second day (lochia cruenta), showing a few cocci and streptococci: *a*, Decidual cells; *b*, red blood-corpuscles; *c*, white blood-corpuscles; *d*, epithelium (Winckel).

Fig. 228.—Lochia on the fourth day: *a*, Decidual cells; *b*, white blood-corpuscles; *c*, a few red blood-corpuscles; *d*, epithelium; *e*, micro-organisms (Winckel).

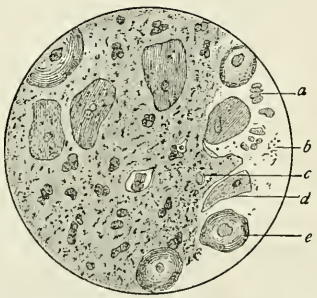


Fig. 229.—Lochia on seventh day; afebrile case: *a*, Blood-corpuscles; *b*, diplococci and monococci; *c*, white blood-corpuscles; *d*, epithelium; *e*, decidual cells (Winckel).

There is a greater unanimity of opinion in regard to the involution of the serous covering, connective tissue, blood-vessels, and mucous membrane of the puerperal uterus.

Mayor[1] found, in the peritoneal covering of the uterus after delivery, a number of folds in the membrane; at the bottom of these folds the endothelial cells seemed to be transformed into a spherical shape. Kilian[2] found the cells in this region infil-

[1] *Loc. cit.* [2] *Loc. cit.*

trated with fat-globules. Bernstein[1] in a study of involution in the rabbit's uterus, paid especial attention to the behavior of the connective tissue. He found that the reduction of this tissue in the puerperal uterus was effected by a fatty degeneration of the connective-tissue cells, and by a drying out, as it were, of the connective-tissue fibers; these, deprived of the excessive blood-supply of pregnancy, dry up and shrink. Bernstein incidentally mentions the fatty degeneration of the peritoneal endothelium, and expresses the opinion that the muscle-cells, while they do undergo a fatty degeneration, are not completely destroyed.

The chief changes in the blood-vessels seem to be shrinkage, the obliteration of many large vessels by a connective-tissue growth in the intima, associated with fatty degeneration of the media,[2] and the development in the adventitia of the vessels not obliterated of new elastic fibers.

The involution of the endometrium is now clearly understood, thanks to the investigations, first, of Friedländer,[3] then of Kundrat,[4] Engelmann,[5] Langhans,[6] Leopold,[7] Wormser,[8] and others. When the ovum is cast off at term, it carries with it, in the strictly normal case, the whole ovular or epichorial decidua and the upper cellular layer of the uterine decidua, leaving behind on the uterine wall the lower cellular layer and the glandular portion of the uterine mucous membrane. This membrane, deprived in great part of its nutriment by the contraction of the uterine wall and the obliteration of many of its blood-vessels, loses its vitality in that portion furthest removed from its source of nutriment—the superficial layer of decidual cells. These die and are cast off with the lochial discharge in a condition of coagulation-necrosis, fatty degeneration or disintegration. By the shedding of these cells the glandular layer of the decidua is laid bare. Now the involution of the endometrium ceases and a regeneration of the membrane begins. The epithelial cells within the glands take on an active growth and reproduction; the interglandular connective tissue shares in the new development; by its growth it rises in embankments between the glands, making them deeper, and so in time reproduces the characteristic utricular glands of the uterine mucous membrane. This process requires some time. Mayor says: "On the twenty-fourth day after delivery I have

[1] "Ein Beitrag zur Lehre von der puerperalen Involution des Uterus," D. i, Dorpat, 1885.

[2] Balin, "Ueber das Verhalten der Blutgefässe im Uterus nach stattgehabter Geburt," "Archiv f. Gyn.," Bd. xv.

[3] "Physiol. Anatom. Untersuchungen über den Uterus," Leipsic, 1870; "Archiv f. Gyn.," Bd. ix.

[4] "Wien. med. Jahrbücher," 1873.

[5] *Ibid.*

[6] "Archiv f. Gyn.," Bd. viii.

[7] *Ibid.*, Bd. xii.

[8] Wormser, "Die Regeneration der Uterusschleimhaut noch der Geburt.," "Arch. f. Gyn.," Bd. lxix, H. 3 (good recapitulation on p. 565).

not found glands in the region of the placental insertion. The mucous membrane, although reconstructed at the second month, is then furnished with fewer glands, less regularly disposed, and of a greater caliber than in the normal state."

The uterus is not the only organ of the sexual system that experiences a retrograde change after labor. The ovaries and tubes, the broad and round ligaments, the pelvic connective tissue, blood-vessels, and lymphatics, all undergo modification. That portion also of the birth-canal—the lower uterine segment, the cervix, the vagina, and the vulva—which is dilated to an extreme degree to allow the passage of the fetal body, must likewise exhibit rapid involution to regain its wonted tone and caliber. In these structures the process is mainly one of retraction of overstretched tissue; but there is, in addition, a certain amount of degeneration and atrophy of the redundant cells that the increased blood-supply and increased stimulus to growth of pregnancy called into existence. Particularly is this true of the lower uterine segment and cervix, which in their involution display an intermediate process between that by which the reduction of the uterine body is effected and that by which the lower portion of the parturient tract regains its normal state.

The involution of the uterine adnexa progresses satisfactorily if the uterine involution itself is normal. The reduction of the overstretched vagina and vulva is sure to occur if these parts have not been seriously lacerated, although, like all overstretched muscular canals, they never quite return to their original caliber.

From the large sinuses at the placental site, laid bare after the separation of the placenta; from the innumerable little vessels of the decidua that have been torn in the separation of the ovum from the uterus; from the rents of various degrees that have been made in the cervix, vagina, and vulva during labor, it is inevitable that there should be, for some time after delivery, an oozing of blood in considerable quantity. As the residue of the decidua and the blood-clots remaining in the uterine cavity are disintegrated, the products of this decomposition must also escape externally. And as the whole genital canal, lined by a mucous membrane, is stimulated and irritated by foreign substances and a large blood-supply, it is obvious that the mucous secretion of the genital tract will be considerably increased, and must make its escape also from the vagina. This composite discharge after labor, made up of blood, degenerated epithelial cells, the débris of disintegrating animal material, mucus, and large numbers of harmless micro-organisms, is called "the lochia."[1] It is important to appreciate the normal character of

[1] A word derived from the Greek λόχος, pertaining to a woman in child-bed.

this discharge, for changes in its quantity, odor, or constituent parts often point to some morbid process. The older writers on obstetrics paid great attention to this feature of the puerperal state, and gave to the discharge three names, which indicate the three changes that it undergoes in appearance. For the first five days it is called lochia rubra; for the next two days, lochia serosa; and after that, lochia alba. At first, as might be expected, the discharge is almost wholly bloody—the lochia rubra. As the repair of the injuries of parturition progresses and the hemorrhage ceases, the discharge is a serous exudation and a catarrh of the mucous lining of the genital tract—the lochia serosa. The dead tissue in the genital canal is cast off in increasing quantities as the involution of the birth canal progresses; disintegrated and fatty epithelial cells are mixed in the discharge; micro-organisms are found in it, while the pus from the granulating wounds all along the genital tract forms an important constituent of the discharge after the sixth or seventh day. To the lochial discharge at this period is given the name lochia alba. The last stage of the lochial discharge lasts from the seventh until the tenth, twelfth, or fourteenth day, or even longer. Two other features of the lochial discharge are also of clinical interest—the quantity and the odor. The amount of discharge at the three different periods may be expressed scientifically thus: During the first four days the amount of discharge is 1 kilogram, or 2.2 pounds; during the next two days, 280 grams, or about 10 oz. Avoir.; and until the ninth day, 205 grams, or about 7 oz. Avoir., the entire loss amounting to 3¼ pounds. These figures, however, are of no value to the practical clinician.

No physician in private practice can accurately measure the amount of lochial discharge; so that the convenient method of estimating it has been adopted of noting the number of napkins or pads that are soiled in the twenty-four hours. The normal puerpera should not require a change of the vulvar pads oftener than six times in the twenty-four hours for the first four or five days. The importance of being able to distinguish between a normal and abnormal amount of lochial discharge is obvious. Otherwise a dangerous hemorrhage might be overlooked; a diminution or even suppression of the lochia might be unnoticed.

The odor of the lochia during the period of sanguinolent discharge is that of fresh blood or raw meat. Later, when the mucous secretion forms a considerable part of it, the predominant odor is that peculiar to the secretion from these parts. If masses of decidua, placenta, membranes, or blood-clots are retained *in utero* and saprophytes gain access to them in a situation favorable to their decomposition, the lochia at once takes on a putrid odor. This is frequently the first signal of a

possible toxemia. While recognizing the value of a putrid odor as a danger-signal, it must be remembered that absence of odor is possible with dangerous streptococcic or staphylococcic infection.

The involution of the uterus has been described as a continual process, moving on evenly from beginning to end. But as it depends primarily upon the contraction of the uterine muscle-fibers it is indicated graphically by a series of waves, representing contractions of the uterus of more or less force and frequency and intermissions of less firm contraction; the retraction of the uterine muscle, however, maintaining fairly well what is gained by contraction. Each case has a certain degree of individuality; in one the contractions are firm and the intervals between them short; in another it is the reverse and all gradations may be found between the extremes; but while there are in every case individual peculiarities, the action of the uterus after labor is governed by a few general laws. Directly after labor there is a firm contraction which reduces the size of the uterus in all directions below the measurements obtained a few hours later; then follows a relaxation, the fundus rising 2 cm. or more and its breadth increasing by more than a centimeter. Suckling the child stimulates the contraction and retraction of the uterus. If the child is not nursed involution is slower and less complete. In primiparæ, the uterus being more powerful, better supplied with muscular tissue than it will ever be again in a subsequent confinement, contracts so vigorously, relaxes so little, that after the expulsion of the placenta the uterine cavity is almost obliterated, and the amount of bloody lochia is reduced to a minimum. On the other hand, in multiparæ, the uterine muscle being in some degree weakened by stretching and perhaps by some destruction of muscle-substance that has occurred in previous pregnancies, the uterus after labor does not contract so firmly and the relaxations between the contractions are greater in degree and duration. If the uterine muscle has been overstretched, as it is in plural pregnancies or in cases of hydramnios, or if the labor has been exceedingly long or unusually precipitate, very firm contraction does not appear after labor and there are apt to occur periods of over-relaxation. This condition, in civilized women, is so very common that it is necessary to study it under the head of the physiology of the puerperium, and yet the consequences of a failure on the part of the uterine muscles to contract with maximum intensity after labor are always unpleasant, and may be disastrous. A relaxation of the uterine muscle-fibers implies a loosening of the countless living ligatures that bind the large vessels of the puerperal uterus. The immediate effect is an escape of blood into the uterine cavity. Oozing out gradually from the imperfectly closed blood-vessels and sinuses, and, finding space in the enlarged uterine cavity to

collect, it forms clots often of considerable size, which act upon the uterus, like any foreign body in it, as an irritant, exciting it to active contractions which only cease when the foreign substance is expelled. These active contractions of the uterus are always painful, with a pain like that of a cramp in any muscle.

These painful contractions, affecting the uterus after delivery, caused primarily by lack of firm contraction, and immediately by the presence of clots of blood *in utero*, are called, *after-pains*,—the painful contractions of the uterus after labor. For the reasons already given they are not experienced by primiparæ unless the uterus has been unduly distended or the labor has been too prolonged or too precipitate. On the other hand, they are a constant phenomenon in multiparæ, and the physician's treatment of them constitutes almost always a part of his routine management of the puerperal state in such patients. Apparently a trifling matter, it is really one of considerable importance. In the first place, the pain is sufficiently distressing to demand relief, but, more important still, these after-pains indicate, to the educated physician, the presence within the uterus of blood-clots or other putrescible material; and until they are expelled, and the uterus is induced to remain in a state of firm contraction, the woman is not entirely safe from septicemia. Moreover, it is necessary to be familiar enough with the clinical features of after-pains to be able to distinguish them from the pain of peri-uterine inflammation. This should not be difficult. The intermittent character of after-pains; their cramp-like nature; exacerbations when the child is suckled; the fact that pressure does not increase the pain, and that the pulse and temperature are unaffected, suffice to distinguish the painful contractions of the uterus after labor from the pain of inflammation.

The appropriate treatment of after-pains is suggested by their cause and nature. It is the administration of ergot to stimulate vigorous contraction and firm retraction of the uterine muscle, and of opium to diminish the pain of the contraction. A mixture of fluid extract of ergot and paregoric is a useful prescription, though, in cases of extreme pain, ergot by the mouth and morphin hypodermatically give a better and quicker result.

Although the most remarkable changes that occur in a woman's organism after labor are seen in the genital organs, the whole body undergoes a modification. The respiratory, circulatory, nervous, and excretory apparatuses are affected, with accompanying peculiarities of respiration, pulse, temperature, weight, the excretion of urine and sweat, and the evacuation of the bowels, while the nervous system shows a gradual change from the nervous irritability characteristic of pregnancy to the degree of equanimity that the individual may have before possessed.

Alterations in the Circulatory Apparatus of the Puerpera.—The pulse of a woman during labor is rather rapid, full, and bounding; directly after delivery it becomes preternaturally slow; if the individual's normal pulse-rate were 70 to 80, it might, during labor, rise to 90, but directly afterward it sinks, perhaps, to 60 or even lower. It is occasionally as low as 40 in a perfectly healthy young woman. In looking for the cause of this alteration in pulse-rate one must recall the influence of gestation upon the heart and the alterations in the constitution of the blood during pregnancy. The whole volume of the latter is increased, but not by an equal increase of all the constituent parts; the corpuscles are relatively decreased in proportion to the liquor sanguinis; the watery element of the blood is proportionately increased, making the condition of the blood during pregnancy one of hydremia. There is a relative decrease of albumin, blood-salts, and the percentage of hemoglobin, a relative increase of the fibrin-making ferment. Expressed definitely, this decrease is to the extent of about 700,000 red blood-corpuscles per cubic millimeter and about eight per cent. of hemoglobin. Within the first twenty-four hours after labor the decrease in red blood-corpuscles and hemoglobin is yet more marked, on account, no doubt, of the escape of blood in the third stage of labor and immediately after it. But after the first twenty-four hours the blood begins to recover its normal constitution, and at the end of two weeks it is so far on the road to perfect involution that it is much nearer a normal condition than it was in the latter half of pregnancy, although it is still somewhat deficient in red blood-corpuscles and in hemoglobin.

The leukocytes decrease rapidly after labor, reaching their minimum number twelve hours post-partum; the number then increases as a moderate leukocytosis until lactation is established, whereupon the number is again diminished.

These changes, however, do not explain the cause of a slow pulse in the puerperal state: it is discovered in the heart. It is claimed that the area of cardiac dullness is increased in pregnancy, and that there is a hypertrophy of the walls of the left ventricle. As the whole volume of blood is increased in pregnancy, and as additional resistance to the circulation is offered by increased intra-abdominal pressure and by direct pressure of the uterus upon the pelvic vessels, it is reasonable to assume that the heart, in addition to being hypertrophied, is also dilated. The additional force and capacity of the heart is acquired to meet the additional demands of pregnancy: A greater volume of blood is propelled through the vessels by an enlarged and strengthened heart, beating with a normal rapidity. Labor comes on, the uterine cavity is emptied, and suddenly

the increased vascular power has become unnecessary if not dangerous. The amount of work done by the heart is represented by two factors; the rapidity plus the strength of the beat and the power of the heart can be lessened by diminishing either one of these factors. It is obvious that the increased power of the hypertrophied heart-muscle can not be abrogated in a moment. It is equally obvious that the other factor in heart-power can be modified at once to suit the new and lesser requirements. And this, probably, is the method nature adopts to avoid excessive heart-action and an excess of blood in important organs after labor. The heart-beats are reduced some twenty to thirty in a minute.

Changes in the Urinary System After Labor.—The physician is often annoyed in obstetrical practice to find that many women after labor are unable to urinate and consequently require the use of a catheter, which must be employed in many cases by the physician himself, especially in country practice.

To comprehend the changes in the urinary system it is necessary again to revert, for a moment, to pregnancy. The main changes in the kidney, bladder, and urine in that condition may be thus summarized: The kidneys, by reason of additional supply of blood and extra work to do, are hypertrophied; the urine is increased in water, diminished in solid constituents, except chlorids. The bladder, in pregnancy, from the pressure of the gravid uterus behind, is unable to expand in a normal manner, but must accustom itself to a distention, chiefly upward. When the uterus is empty and has shrunk to half its former size, the bladder has room at once to distend in all directions, and can thus hold a very large quantity of urine before its walls are subjected to the same degree of tension to which they were accustomed during pregnancy. Thus large quantities of urine may collect before there is a disposition to urinate. Moreover, the abdominal walls, so long kept on the stretch, are suddenly released from the intra-abdominal pressure, and do not for some time regain their tone; so that the action of the abdominal muscles, which are, perhaps, the chief factors in emptying the bladder, is, to some extent, inhibited. In some women recently delivered the abdomen is scaphoid, so that a contraction of the abdominal muscles actually decreases, instead of increasing, intra-abdominal pressure. There is a third reason for the retention of urine after labor: The tissues immediately behind the symphysis pubis bear the brunt of the pressure of the child's head as it descends the birth-canal; and this pressure is exerted not directly forward, but to one side or the other, by the oblique position of the head; the tissues about the urethra are left edema-

tous after labor, from the contusion they have suffered, and the urethra is dragged a little to one side, so that in a twofold manner the urethral canal is partially occluded, namely, by the edema of surrounding parts and by the acquired tortuosity in its course. The urine itself does not differ much from that of pregnancy. The water is increased; the urea and solids are both relatively and actually below the normal. Glycosuria is quite common. Blot claims that the sugar in the urine is the result of the absorption of lactose from the mammary glands, and that the larger the secretion of milk, the greater the quantity of sugar in the urine, and therefore he proposed that the quantity of sugar in the urine be taken as a test for the suitability of a wet-nurse. It has been claimed, by others, that the sugar has a hepatic origin.

About 50 per cent. of puerperæ have albuminuria.

Fischel declares that peptonuria is a constant phenomenon of the normal puerperium.[1]

The **sweat-glands** after labor are unusually active. The skin of a pregnant woman is often harsh and dry, and during labor, unless the muscular effort is great or the weather warm, the same condition of the skin persists. But in the puerperal state the sweat secretion is profuse; the skin is constantly moist, and during sleep the secretion may become excessive. This action of the sweat-glands plays an important part in the involution of the whole organism after labor. It is one of the factors by which the hydremia of pregnancy is corrected, and by the dissipation of heat that accompanies the rapid evaporation of water all over the body the temperature in the puerperal state is retained at a normal level, in spite of many provocations to fever.

The lungs after labor take on a slightly different action. Their capacity is increased, for the pressure from below is removed and the play of the diaphragm is freer. Each inspiration drawing in more air than before, the number of respirations in the minute is lessened; the breathing is deeper, fuller, quieter, and slower than it was during pregnancy, and the expired air contains an excess of water and of effete products, the result of tissue destruction. As a result of the great excretion of water from the kidneys, the skin, and, to a lesser extent, the lungs, the thirst of the lying-in woman is increased; the appetite, on the other hand, is much diminished. One can understand the last statement if he recalls the fact that more than a pound of meat in the involuting uterus is absorbed into the system during the puerperium, and if he remembers that the woman is lying in bed absolutely quiet and expending no force whatever in muscular action. There is still another factor to account for the disinclination toward food. During pregnancy there is no one tissue, except that contained within

[1] "Arch. f. Gyn.," Bd. xxiv u. xxvi, S. 120 u. 400.

the developing uterus, which increases with so much rapidity as the subcutaneous fat. It seems as if there were provided by nature a store of material which shall take the place of food in supplying heat and force during a period when woman in her natural, primitive state could not be supposed to provide for herself. This deposition of subcutaneous fat during pregnancy and its subsequent absorption during the lying-in period account for the remarkable *changes in weight* which may be noted in a woman during pregnancy and after labor. This is a matter of some practical importance, which does not usually obtain the attention that it deserves. It has been studied systematically by Gassner and later by Baumann. According to Gassner, the gain in weight during pregnancy and the loss afterward are about one-thirteenth of the body-weight. This, I am inclined to think, from some investigations of my own, is an underestimate, and Baumann's observations bear me out; he found that the loss of body-weight was about one-tenth after labor, the greater part of it, of course, occurring in the first week, when a woman of average weight loses some nine or ten pounds.

All the remarkable changes observed in the lying-in woman occasion no manifestation of disease, not even fever. This assertion some years ago would have been incorrect, for fever was so common in the puerperal state that it was regarded as physiological; it occurred usually within the first few days after labor and as, at this time, there were marked manifestations of congestion in the breasts, due to the inception of lactation, it was called milk fever. In reality it was the fever of infection. If, however, the temperature in the puerperal state is studied closely, it must be confessed that there is some little irregularity, but that irregularity is measured, in the normal case, by tenths of degrees. Directly after labor, for instance, the body-heat is always a little raised.

Although there is distinctly no such thing as milk fever, the temperature is slightly affected when the breasts suddenly assume activity; but the rise is rarely more than a few tenths of a degree.

So many causes, transitory in their effect, can produce slight disturbances in the temperature of the lying-in woman, who is peculiarly sensitive to external influences, that the rigid boundary which divides fever from a normal temperature at other times must be a trifle relaxed. Thus, it is agreed among obstetricians not to regard as fever a transient rise of temperature, lasting only a few hours, which does not go above 100.5°. This is the so-called physiological limit to the rise of temperature in the puerperal state.

The Mammary Changes in the Puerpera.—Heretofore the involution of important organs and systems in the puerperal

state has claimed attention. The mammary action after delivery is a process of *evolution.* The mammary glands, as their name denotes, are glandular organs, only reaching their full development, as a rule, in the female; situated, usually, toward the lateral aspect of the pectoral region; occupying the space bounded above by the third and below by the sixth rib, to the inner side by the edge of the sternum, to the outer side by the axillary line. They are derived from the epiblastic layer of the blastodermic membrane, and belong essentially to the skin, as do the

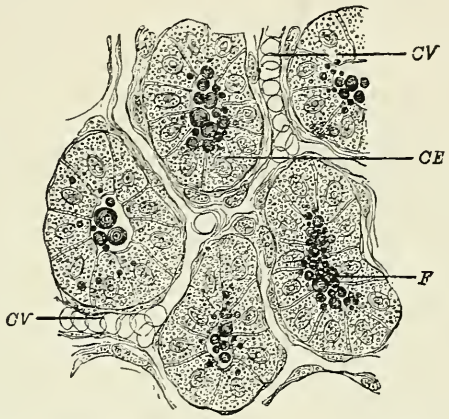


Fig. 230.—*CE*, Cuboidal epithelial cells; *F*, fat globules stained black with osmic acid, and seen both in the cells and in the central cavity of the acini; *CV*, connective-tissue frame with blood-vessels. Magnified 600 diameters (C. Heitzmann).

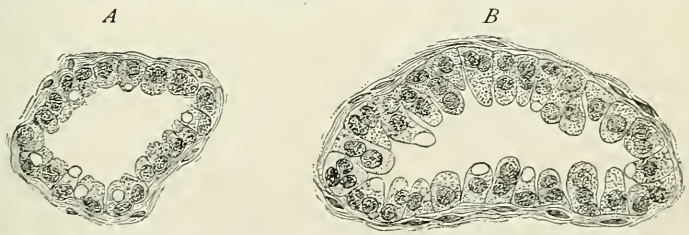


Fig. 231.—Mammary gland of dog, showing the formation of the secretion: *A*, Medium condition of growth of the epithelial cells; *B*, a later condition (after Heidenhain).

sweat and sebaceous glands. They are closely akin to the latter, occurring in rare instances on indifferent parts of the body, as the axilla, the abdomen, or even the thighs, where a sebaceous gland has undergone a specialized development. In the female they are hemispherical in shape; they are held in their normal position upon the pectoral muscles by the superficial fascia, which splits into two layers, one running above, the other below, the breast. Externally, a little below the middle

of the organ, is a protuberance,—the nipple; around this is an area of pigmented skin,—the areola; in this space are a number of large sebaceous glands,—the glands of Montgomery. Internally the breast is divided into excretory ducts, lobes, and lobules; between the lobes and lobules are connective tissue and fat. The lobules are ultimately divided into little vesicles; these empty into a small excretory duct; the small excretory ducts from contiguous lobules unite to form a single large, lactiferous canal; of these there are some fifteen or twenty, each conveying the secretion from a separate lobe to the nipple; just before emerging upon the surface of the nipple each duct is dilated to

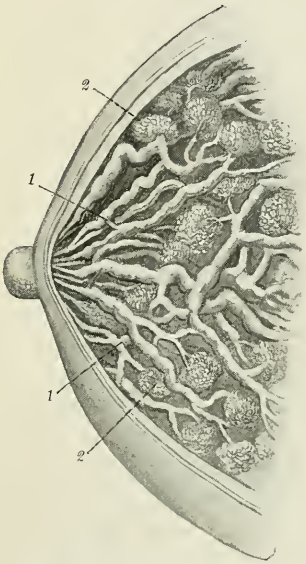


Fig. 232.—Mammary gland: 1, Lacteal ducts; 2, glandular acinus (Playfair).

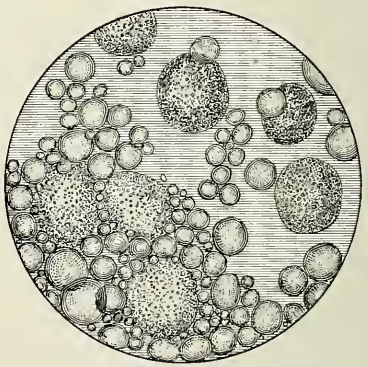


Fig. 233.—Colostrum and ordinary milk-globules, first day after labor; primipara aged nineteen (after Hassall).

form a small ampulla or reservoir for the milk; as it passes through the skin of the nipple it is again contracted. The epithelium of the gland is continuous with that of the integument; in the superficial portions of the lactiferous ducts it is squamous; in the deeper portions of the gland, columnar. The function of the gland is the secretion of milk.

Colostrum.—During the latter part of pregnancy a thin, opalescent fluid may be squeezed out of the breast; directly after labor this fluid is somewhat increased in quantity, and becomes a little whiter and more opaque.

At the end of about forty-eight hours a decided change takes place in the breasts; they suddenly enlarge; the skin over them becomes tense; the cutaneous veins are engorged with blood, and show swollen and distinct beneath the skin; the nipple projects; to the feel the breasts are hard and lumpy; to the woman they are painful and tender on pressure. If the child is applied to the nipple, there runs out, almost without suction, a quantity of human milk—a fluid different from the colostrum just described. It is white, opaque, of a specific

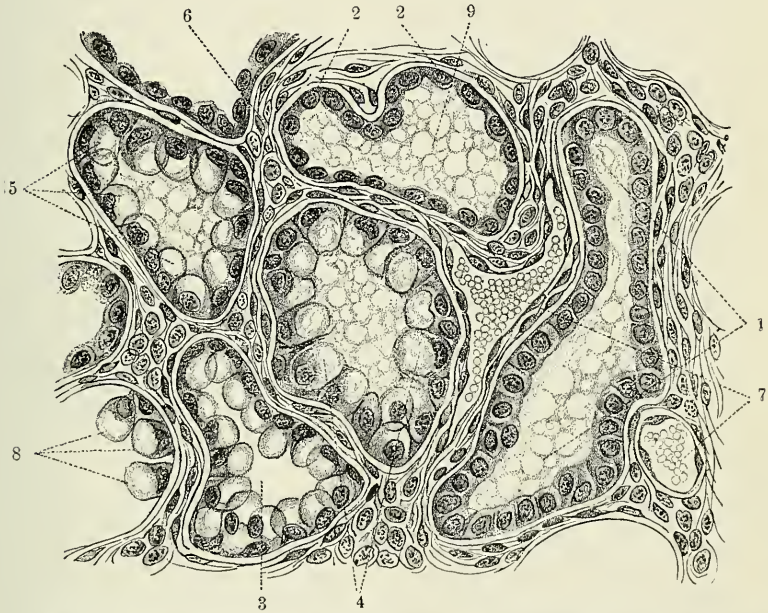


Fig. 234.—The production of milk. Section of the mammary gland of a nursing puerpera (Bumm): 1, Epithelium of acinus inactive; 2, epithelium compressed by milk in acinus; 3, 4, 5, epithelium actively secreting milk; 6, intra-acinous connective tissue; 7, capillaries; 8, secreting epithelial cells with large fat drops in the protoplasm, the nucleus pressed into cell wall; 9, milk.

gravity about 1025, is said to have a sweet, agreeable taste, and is without odor.

The influences which determine milk secretion after childbirth are still a mystery. Lactation is observed even though the spinal and sympathetic nerve connection with the genitalia is severed. Indeed, lactation has occurred in the mammary gland of a rabbit transplanted to its ear five months before. It may be an ovarian secretion, perhaps that from the corpus luteum, which stimulates milk production, but this theory does not account for milk secre-

tion in the infant during the first few days after birth, in young girls, in cases of imaginary pregnancy, in women with pelvic or abdominal tumors, and in men.

The quantity of milk secreted in the twenty-four hours is difficult to determine. It might seem easy enough to draw the milk from the breast at stated intervals with a breast-pump and to measure it, but it is difficult to get a breast-pump as mechanically effective as a child's mouth, and, moreover, the secretion of milk depends, to some extent, upon the maternal emotion; the breast might almost be described as an erectile organ; certainly, the sight of the child arouses a maternal instinct which sends an additional blood-supply to the mammary gland and undoubtedly increases the supply of milk. It has been estimated that at first the quantity of milk is about 300 to 400 grams (10 to 13¼ fl. oz.); by the seventh day it is 400 to 500 grams (14 to 17 fl. oz.); after the second week, 1500 to 2000 grams—1½ to 2 liters (3 to 4 pints).

In a microscopic section of a mammary gland, procured during lactation, there may be seen large epithelial cells in the process of proliferation. Toward their inner periphery may be seen globules of fat. One of two things must happen to account for the production of the milk: either the whole cell, which has begun to show signs of fatty degeneration, or rather fatty metamorphosis, is cast off, then bursts and discharges its contained fat, as well as other cell-contents, into the liquid medium which has exuded from the blood, or else each cell, having accumulated its store of fat, discharges it in little globules, along with the casein, which must also be derived from the cell-contents. The latter process is the one generally accepted.

The Diagnosis of the Puerperium.—Occasionally it is important for a physician to be able to decide by an appeal to his own senses, without regard to the woman's statement, whether or not she has been recently delivered. Women accused of infanticide, for example, may deny their recent delivery. The diagnosis, in such a case, is not difficult. The large uterus, reaching to the umbilicus; the bloody discharge, showing, under the microscope, decidual cells; the secretion in the breasts; the characteristic fragments of decidua that may be scraped out of the uterine cavity with a curet; the rents in the cervix, the vaginal mucous membrane, and the perineum; the relaxed abdominal walls, and the striæ upon them,—all unite to make the diagnosis easy to establish and absolutely sure.

Management of the Puerperium.—The prevention of infection must be the chief care of both doctor and nurse in charge of a puerpera (see The Preventive Treatment of Puerperal Sepsis).

Having secured, so far as possible, a perfect cleanliness of physician, patient, all her surroundings and attendants, and of the air of the room in which the woman lies, one has performed by far the most important part of his duty in the management of the puerperal state, and has averted the commonest and most fatal accident of this period—septic infection. Being secure of this most desirable result, the physician may turn his attention to some lesser matters, of no little importance, however, to the comfort and even safety of the patient.

Visits.—It is wise to wait in the house for an hour after the woman's delivery, to see that there is no hemorrhage. She should be visited again in about twelve hours; then once a day for the first two weeks, every other day during the third week, and once or twice in the fourth week. For the first week at least the following items should be investigated routinely at each visit: The pulse; the temperature; the odor, quantity, and character of the lochia; the condition of the bladder and size of the womb, learned by abdominal palpation; the condition of the breasts and nipples; the occurrence of after-pains; the evacuation of the bladder and bowels, and last, but by no means least, the condition of the infant. Many physicians fall into the habit of neglecting the baby altogether. There could be no worse policy, not to speak of higher considerations. The mother resents an indifference to her infant's condition, and a failure to make a routine investigation at each visit of the child's feeding, sleeping, and gain in development; of its umbilicus, its bowel and bladder evacuations, and digestion, often results in a failure to correct some abnormality until it is too late. Many a sudden and inexplicable death in the new-born could have been avoided by greater watchfulness and care.

Rest and Quiet.—The woman recently delivered is the picture of perfect restfulness and repose. There is reason enough for this mental and physical quiet after delivery. The relief from great suffering and tremendous muscular effort would naturally induce a feeling of lassitude, and fortunately it is preëminently the case after labor, for this condition of perfect repose is most favorable for the occurrence of the complicated phenomena of the puerperium without detriment to the woman's health. It seems almost superfluous to insist upon the advisability of accepting this hint from nature in the management of the puerperal state,—of preventing any mental or physical disturbance, muscular effort, a glaring light, loud conversation, and, more than all, the entrance into the lying-in room of a single person whose presence is not necessary,—and yet this is a matter that in many cases requires the physician's express attention. Among more

ignorant people particularly, and especially if there has been some unusual complication or accident in the labor, the patient, upon the second visit, may be found restless, with a rapid pulse, an anxious expression, and an elevated temperature, and on inquiry it is learned that a constant stream of her female neighbors has been pouring into her room with minute inquiries into the particulars of the case, and often with gloomy forebodings as to the result, based upon their recollection of just such a case which ended fatally. It was the custom in France in the seventeenth century to baptize the infant on the third or fourth day, when a collation was served in the lying-in room, to which all the friends of the family were invited, who were expected to drink the mother's health with much hilarity and many congratulations,—a ceremony lasting through a whole afternoon. Mauriceau speaks of this as a "very ill custom." We must agree with him, and should be inclined to go to the opposite extreme in enforcing rest and seclusion during the whole lying-in period.

The physician must give specific directions in regard to the following matters, under the head of Rest and Quiet:

1. The position that the patient must occupy in bed, and how long she must retain it. The length of time she must remain in bed. The earliest date she may stand upon her feet, and the time when she may go down-stairs.

2. The degree of quiet and decorum to be observed in the room; and—

3. The admission of visitors.

The rules in regard to these matters, expressed, as rules, dogmatically, might run as follows:

1. The patient shall lie flat on her back and shall not be allowed another posture for at least a week.[1] For the first six hours after labor the head shall not be supported by a pillow, but shall be on a level with the body, in order to avoid a disposition to cerebral anemia and syncope, from the greatly decreased abdominal pressure.

The woman must lie in bed until the involution of the uterus is so far complete that the fundus uteri has sunk to the level of the symphysis pubis or below it. It is a safe rule to insist upon strict confinement to bed for fourteen days. Then the patient may be allowed to shift herself from the bed onto a lounge rolled alongside of it, passing the day upon the lounge and sitting up as long at a time as she can without fatigue. At the

[1] This rule is sure to be a little relaxed by the patient and nurse. If the former is allowed to roll about the bed at will, the ligaments of the uterus are stretched as the uterus falls from side to side with the movements of the patient, and displacements ultimately are more likely than if she had kept quiet. There is, besides, the rather remote danger of displaced thrombi and sudden death from embolism.

end of three weeks she begins to walk about the room, and at the end of four goes down-stairs for the first time.

2. The woman's rest must be mental as well as physical; therefore, no loud noises should offend her ear, no glaring light should irritate the eye, and no extended conversation should be allowed in the lying-in room; at any rate, for the first few days.

3. No visitor should be allowed in the lying-in room except the patient's mother and her husband, and it is sometimes necessary to restrict the visits as to frequency and length.

These rules in regard to quiet after labor will suit the average case among the upper classes. They must, however, be modified on occasion. The length of time, for instance, required for the involution of the uterus varies greatly in different classes of society. An Indian tribe on the march does not halt because a woman falls in labor; she retires to the bushes, gives birth to her infant, cuts the cord, dresses the child, and plunges into the nearest stream to cleanse herself; remounting her pony, she soon rejoins her tribe with the new-born infant slung on her back. The involution of her uterus goes on rapidly, in spite of this heroic treatment. In the Frauenklinik in Munich, in which the author once served as volunteer interne, and where the patients are mainly strong Bavarian peasant girls, the fundus of the uterus was usually beneath the symphysis pubis on the sixth day. On that day the patient left her bed; the following morning she walked out of the hospital with her infant in her arms. In the more artificial life of the upper classes much of the primitive woman's physical vigor is surrendered for increased mental culture. In these women labor is usually difficult and painful, if not dangerous; the puerperal state is often more complicated than it should be, and involution of the uterus may be delayed.

No patient should be allowed to leave her room before a careful vaginal examination has been made, to ascertain the position of the uterus.[1] This one examination, however, is not sufficient. Even after involution is almost completed, when the woman resumes, to a certain extent, her normal activity, a uterine displacement is not unlikely to occur. Overexertion or exposure will almost certainly bring on a renewal of the bloody lochia; the involution of the uterus may be arrested before its perfect completion; even septic inflammation may attack the uterus and its appendages as late as the fourth week. It should be an invari-

[1] If the uterus is found retroverted between the third and fourth week, it should be replaced, and the patient instructed to assume the knee-chest posture twice a day for five minutes at a time. I find the postural treatment of displacements of the puerperal uterus permanently successful in a considerable proportion of cases. A pessary is contraindicated before the sixth week.

able rule of practice, therefore, to examine every child-bearing woman six weeks after her delivery, digitally and with the speculum, noting the position of the uterus, its involution, the condition of the pelvic connective tissue and uterine appendages, possible injuries to the cervix, anterior vaginal wall, and pelvic floor, erosions of the cervix, the condition of the abdominal wall, and the character of the uterine discharge. Abnormalities are often found at this period, which were not noticeable or were not present before the woman left her room. The question whether the routine administration of ergot would insure perfect involution or hasten its completion has occurred to many minds, and has found its answer in practical experimentation. Numbers of women have been placed on a routine treatment of ergot three times a day, and the progress of these cases has been carefully compared with that of an equal number of women left to nature. The result of these observations has not been favorable to ergot as a sure means of shortening the duration of the puerperal state: nothing was gained in point of time, while disadvantages were found in this plan of treatment that might have been foreseen. The stomach rebels against a prolonged use of the drug in considerable quantities. While contracting the uterus, it has an astringent action also on the breast and so diminishes milk secretion, and, passing from the maternal blood into the milk and into the infant's stomach, it exerts an unfavorable influence upon both mother and child.

The diet is a matter of no small importance, about which there is considerable difference of opinion. On the one hand, it is held that the woman after labor is weak from loss of blood and from fatigue; that she must, therefore, receive the most nourishing food in the largest possible quantities. Moreover, that the demand which will soon be made upon her economy for the nourishment of the child is an additional reason for the administration of a generous diet from the first. But a close observation of nature should lead to the opposite view. A large part of the involuting uterus is absorbed into the system; some two pounds of meat are thus, as it were, devoured, the greater part of it in the first few days of the puerperium. A large quantity of fat is stored up in the body during pregnancy with the express purpose, it would seem, of providing a means of supporting the woman during the early part of the puerperal state. Thus nature provides a sustenance which in quantity certainly appears sufficient for at least the first few days after confinement, and in form and manner of ingestion, so to speak, is best calculated to support the woman's strength, with none of the expenditure of force involved in mastication and digestion. Moreover, it must be remembered

that almost all the vital functions are performed in a sluggish manner for the first few days after labor. The pulse is less rapid, the respiration slower, the bowels are inactive, and there should be no voluntary muscular effort. All this seems to argue for the wisdom of a system which allows, for the first few days, nourishment small in quantity, of a form easily ingested, and of a quality readily digested. After the third day, however, a new element must be taken into account. At that time there begins the milk secretion, which undoubtedly entails a great drain on the whole system to provide the large quantity of fat and nitrogenous material which are excreted when the breasts have assumed their full activity. To meet this additional demand upon the resources of the body the simple diet of the first few days should be materially, though gradually, increased; for the first onset of the physiological mammary action is usually so violent as to stop just short of a pathological condition,—inflammation,—and suddenly to exhibit large quantities of nutritious food at this time would very likely cause a transgression across the boundary-line between health and disease. This, however, is mere theoretical reasoning, and if applied in practice it fails to give the best results, the system dependent upon it should be ruthlessly discarded, no matter how reasonable it may appear. But a practical test has given the result that might be expected. No one who has compared the two methods—one, of giving a forced diet from the first; the other, of giving a very light diet, chiefly of milk, for the first two days, and afterward gradually increasing it until, on the sixth or seventh day, the patient is taking the food that would be suitable to any healthy person confined in bed without physical exercise—can fail to notice that the latter plan secures a far greater immunity from congestion of the genitalia and breasts, from irregularity in the milk secretion, and from disturbances of the stomach and bowels.

Urination.—The tendency to retention of urine that is so often met with, especially among women city bred and in easy circumstances, has already been noticed. This is an abnormality in the puerperal state of civilized woman that is, perhaps, as annoying as any one feature of a normal case. Its causes have already been described. Its detection would seem perfectly easy, and yet it is just as easy to overlook it without the careful attention which should be, but is not always, directed toward this point. It is a common experience for a consultant to be asked to see a woman some days after labor, because the attending physician thinks that alongside the uterus there is a large and peculiar abdominal tumor, and the patient suffers great pain. What is taken for the uterus is an immensely distended

bladder, reaching half-way or quite to the umbilicus; the peculiar abdominal tumor is the uterus itself pushed far upward and to one side, almost always the right. Catheterization removes immediately both tumor and pain. The mistake on this point often arises from the trust that the physician puts in the woman's statement that she has urinated regularly. One should never trust any one's assertion as to action of the bladder, but should always examine for himself, by abdominal palpation, to see if it is full or not. A nurse sometimes falsely asserts that her patient has urinated, because she is ashamed to confess her inability to pass a catheter. If the urine must be drawn, the catheter is used by a trained nurse, should there be one.

In her absence the physician himself must attend to the catheterization; even if a skilful nurse is in attendance, the physician is not infrequently appealed to, as the nurse can not discover the urethra, or is unable to insert the catheter. It is well, therefore, under all circumstances, to know how to use a catheter and to have a definite opinion as to the kind of instrument that should be employed. A soft-rubber catheter is to be preferred, because it is incapable of doing any harm, does not irritate the urethra, and is easily cleansed and kept clean. After being used it should be rinsed out and should be kept permanently immersed in a 1 : 2000 solution of sublimate. Before being used it must be dipped in a basin of sterile water, and its tip should then be oiled. The hands of the individual who inserts it must be aseptic. It saves time and is safer to wear rubber gloves, which have been soaked in a 1 : 1000 sublimate solution or have been boiled. To introduce the catheter, it is necessary to expose the urethra to view, to wipe off its orifice, as well as the surrounding mucous membrane, with a piece of absorbent cotton moistened with a sublimate solution, 1 : 2000. The catheter is then inserted directly into the urethra, so that it does not carry with it into the bladder some of the decomposing vaginal discharge, which would be likely to set up a very troublesome or a very dangerous cystitis. The old practice of locating the urethra by the sense of feel, using the finger of the left hand and then introducing the catheter held in the fingers of the right hand, under a sheet, is unreservedly condemned.

In the Directions to Nurses, appended to this chapter, occurs the passage, "Twelve hours after labor the woman shall be catheterized, and after that three times a day if necessary." Twelve hours may seem a rather long period to allow urine to collect after labor; but the bladder is capable of great distention at this time; almost all the natural processes are sluggish; the kidneys directly after labor are not very active,

and if the catheter is used too soon, the patient is very likely committed to its use throughout the greater part of the lying-in period, whereas if the woman can be induced to urinate naturally at first, there will be no difficulty afterward. At the same time it would be unwise to allow an overdistention of the bladder; twelve hours, therefore, is a good compromise time for the first use of the catheter. After that three times a day is usually quite sufficient; it should not be used less frequently, and if the patient's feelings demand it, the bladder must be emptied more frequently. By this plan it is necessary to use the catheter in about thirty per cent. of primiparæ. It is possible, by a longer delay, to reduce this proportion materially. In the Baudelocque Clinic they wait twenty-four hours or longer and have used the catheter in 6666 cases only twenty times.[1] Before resorting to catheterization every effort should be made to induce the woman to urinate naturally. Sometimes this is accomplished by putting hot water in the bed-pan, by the use of a turpentine stupe over the bladder, and by the sound of running water.

The Bowels.—On account of the small amount of food ingested during the early part of the puerperium, the flaccidity of the abdominal walls, the torpor of the intestinal muscles from long pressure, and the general muscular inactivity, there is a remarkable sluggishness of the bowels, and an exaggeration of the constipated habit almost invariably acquired in pregnancy. This is no great disadvantage at first, as the food is principally liquid and small in quantity, so that there is very little detritus to be thrown off by the intestines. It is not advisable, however, to allow the feces to accumulate too long. If the woman eats in a day perhaps a third of what an ordinary person would devour, by the third day there would be a considerable collection in the lower bowel; at this time, too, the diet is a little increased, and the sudden onset of milk secretion on the third day always seems, at least, to threaten an inflammation of the breasts, which might be averted by a derivative and depletive course. For all these reasons, therefore, it is customary to administer as a routine treatment a laxative on the evening of the second or third day. A good routine prescription is a half-bottle of citrate of magnesia on the evening of the second day, the rest of the bottle the following morning before breakfast, and, if the bowels are not moved two hours later, a simple enema. If the patient is plethoric or the mammary glands are swollen and tender, a more active saline purge is preferable.

The Mammary Glands.—There are many conditions of the breasts, not pathological but troublesome to deal with, of such

[1] Recht, "Thèse de Paris," 1894.

frequent occurrence that they must be considered in the management of a normal case. In almost every instance the establishment of lactation is accompanied by some local disturbance. The increased blood-supply to the breast, the proliferation of cells, and the transudation of a serous exudate are phenomena usually characteristic of inflammation. The enlarged breast, the engorged veins under the skin, the hard, tense feel of the gland-tissue, and the great tenderness, all seem to point to an inflammatory attack instead of a natural physiological process. This state of the breasts usually demands treatment to ameliorate the discomfort and to prevent the transition of a natural process closely bordering on the pathological to a condition of actual disease. If the engorgement of the breasts is marked and the accompanying symptoms of heat, pain, and fullness are pronounced, the administration of a saline purge is usually sufficient to relieve some part of the mammary congestion. Care must be taken, in addition, to empty the breast. For this purpose nothing is

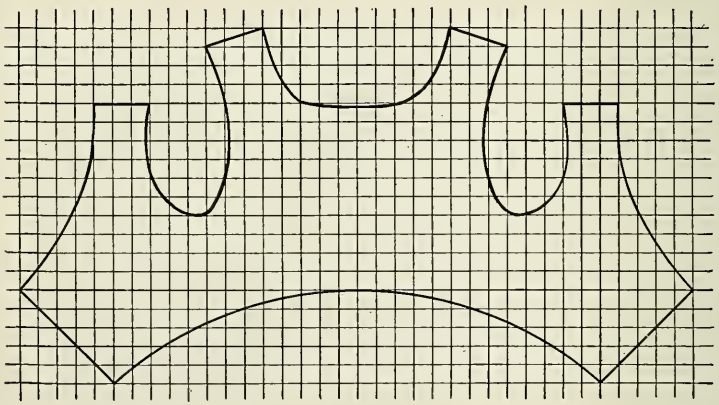


Fig. 235.—Diagram pattern for Murphy-Cooke breast binder. By enlarging until each square represents a square inch, and tracing an outline, a binder of ordinary size will be secured. If the binder is cut from folded muslin, only one-half the pattern need be made.

so good as the infant's mouth, which should be applied to the nipple regularly every two hours. If the child dies, does not empty the breast, or is weaned, a breast-pump must be used, and the nurse, in addition, should rub and massage the breast with oiled finger-tips in a direction toward the nipple, thus making the skin more supple and emptying the breast at the same time. The constant dragging upon the nipple when the child is nursing, the pinching and squeezing it receives from the infant's gums, and its continual

moisture from milk and the secretions of the infant's mouth, all tend to bring about an unhealthy condition of the skin upon and around it. It becomes at first irritated and inflamed, then excoriated, chapped, and fissured, and, consequently, exceedingly sensitive and painful, so that suckling the child is dreaded. Nor is this the only disadvantage; in the little cracks and fissures the milk collects and decomposes; the patient or nurse may, in careless handling of the breasts, deposit, in these raw places, pathogenic micro-organisms, and the consequence is very likely to be septic infection of the connective tissue of the breast and the formation of a mammary abscess—of all the minor complications of the puerperal state the one to be most dreaded. The preventive treatment of this complication is an important part of the management of the puerperal state. The main thing, obviously, is to keep the skin healthy and clean. This is done by carefully washing the nipples after every nursing with absorbent cotton, warm water, and Castile soap; by cautioning nurse and patient against handling the breasts with fingers not aseptic, and by smearing the skin of the nipples and that of sur-

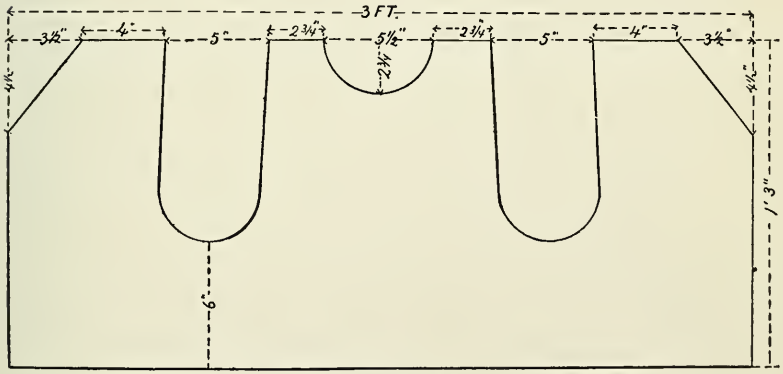


Fig. 236.—The Murphy breast-binder.

rounding parts with sweet-oil after every washing, applied by a piece of clean linen or a pledget of fresh absorbent cotton. There is another point in the management of the breasts, which, if it does not aid in preventing so serious a disturbance as mammary abscess, does increase the patient's comfort by relieving the feeling of distention and weight which is experienced during the first few days of lactation. This is the adjustment of a suitable mammary binder. The Murphy binder or its modification by Cooke is best for this purpose (Figs. 235 and 236).

The Child.—While devoting careful attention to the man-

agement of a woman after confinement, the physician must not forget that he has another patient on his hands, of almost equal importance,—the infant. Fortunately, the management of a healthy infant is easy. If a few common-sense rules are observed, nature does the rest. The management of the new-born child consists simply in seeing that food is administered at proper and regular intervals, that attention is paid to bodily cleanliness, and that ample opportunity is afforded for an almost unlimited amount of sleep; with ordinary precautions in regard to warmth. The proper interval between the nursing should be two hours during the day, four to five hours in the night. If the child is taught regular habits in this respect, the burden of its care-takers is immensely lightened. The infant arouses itself and is ready for nursing at the proper feeding-time, and in the intervals sleeps peacefully. Regularity in nursing is of importance, further, from its favorable influence upon the constitution of the milk. Too frequent nursing results in a concentrated milk, which is difficult to digest. Too infrequent nursing results in a watery milk, which is not nutritious. If the infant is allowed to be irregular in the hours for feeding, bathing, and sleeping, it grows fretful, wakeful, and capricious in its appetite. A word of caution is necessary about the infant's bath. The temperature of the water should be about 90° ; certainly not much higher, nor, on the other hand, too low. Nurses are often extraordinarily insensitive to hot water. The temperature of the bath, therefore, should not be tested by their hands, but by a bath-thermometer. The bath should be given about midday, in the warmest part of the room, preferably in front of an open fire.

There are many apparently small, but really important, details in the preparation for and management of labor and the puerperium, which might easily be forgotten. It is convenient, therefore, to give patients and nurses a printed list of instructions.

DIRECTIONS FOR THE MOTHER.

Send a specimen of urine (mixed night and morning), about four ounces, every two weeks until the last month, then every week. Report at once scanty urination, severe headache, swelling of the feet or face.

Have ready for the labor: towels, ether (one-half pound), brandy (two ounces), vinegar (four ounces) ; four ounces tincture of green soap ; a bottle of antiseptic tablets (corrosive sublimate); a large, coarse, new sponge ; a skein of bobbin ; a fountain syringe ; bed-pan ; new, soft-rubber catheter ; a small package of absorbent cotton ; a one-ounce bottle of carbolized vaselin ; two yards unbleached muslin (for binder); a one-pound package of salicylated cotton ; five yards of carbolized gauze ; eight yards of nursery cloth.

The last is to be boiled for half an hour in clothes-boiler, dried thoroughly, pinned up in a clean sheet, and put away out of the dust. A mackintosh or rubber cloth is necessary to protect the mattress; two yards of rubber cloth, one yard wide, is sufficient. Prescription No. 1[1] is to be procured about four weeks before expected confinement. It is to be applied to the nipples, night and morning, with absorbent cotton. Prescription No. 2[2] is to be obtained about a week beforehand and kept in readiness.

Instead of providing these articles separately, a complete outfit for labor, sterilized, put up in a closed package or box, may be ordered. The author recommends the outfit described in the appended list.

Two sterilized bed pads (30 ins. square).
Two sterilized mull binders (18 ins. wide).
Six sterilized towels.
Stocking drawers, sterilized.
Ten yards sterilized gauze.
Five yards carbolized gauze.
One pound package salicylated cotton.
One pound sterilized absorbent cotton (half pounds).
Rubber sheet 1 yard × 1½ yards, sterilized.
Rubber sheet 1½ yards × 2 yards, sterilized.
Two tubes sterilized petrolatum.
One tube K-Y lubricating jelly.
Tincture green soap.
Fluid extract ergot.
One hundred grams chloroform (Squibb's).
One hundred grams ether.
Boric acid, powdered.
Bichloride tablets.
Talcum powder.
Four quart sterilized douche bag with glass nozzle.
Douche pan, sterilized.
Two agate basins, sterilized.
Bath thermometer.
Sterilized nail brush.
Safety pins.
Sterilized tape.
Sterilized soft rubber catheter.
Sterilized glass catheter.
One pair sterilized rubber gloves No. 7½.

Baby-clothes.

Four to six dozen diapers.
Four to six pairs knit (woolen) socks.
Three to four shirts (woolen).
Four flannel night-skirts.
" " day-skirts.
Four to six white day-skirts.
} All skirts to be made with waists instead of bands.
Six to ten slips.
" " dresses.
Material for four or five flannel bands (45- to 50-cent flannel).
Soft pillow (good size, 14 x 18 inches).

[1] ℞. Glycerol of tannin,
Aqua, ... āā, ℥j
Ol. rosæ, ... gtt. ij.

[2] ℞. Ext. ergot. fld., ... f℥j.

Soft pillow covers.
Knit wrapping blankets.
Sacques, wrappers, bibs, caps, blankets, veils, etc.

Baby's Basket.

Large and small safety-pins.
Talcum powder (box and puff).
Fine, soft sponge.
Soft brush (for hair).
Castile soap.
Cold cream.
Alcohol for rubbing child.
Blunt scissors for nails, etc.
Old linen for cleaning mouth.
Soft towels for bath.
Bath-blanket.
Wooden forms for drying socks.

DIRECTIONS FOR THE NURSE.

Give rectal enema as soon as pains begin (pint of soapsuds, dram of turpentine). Wash the external genitals thoroughly with soap and warm water. As soon as labor begins, fill three pitchers with water that has been boiling for half an hour; tie clean towels over their tops. This water is to be used for all purposes about the patient and for making the antiseptic solutions.

No vaginal injection to be given unless ordered.

Take the temperature three times a day,—morning, noon, and evening.

Place pad of nursery cloth *under* patient; change it when soiled. Occlusive bandage to be made up of salicylated cotton and carbolized gauze, with sterile hands, and to be changed, for the first five days, every four hours.

The external genitals to be washed off four or five times a day with warm corrosive sublimate solution, 1 : 4000, made up with boiled water. Use absorbent cotton for this purpose.

If, at the end of twelve hours, the bladder can not be emptied naturally, use a catheter. Afterward, if necessary, catheterize patient three times a day.

The patient is to lie on her back; she may be moved from one side of the bed to the other several times a day; her limbs may be rubbed with alcohol and water or bathing-whisky once a day.

The nurse's hands must be protected by sterile rubber gloves before catheterizing the patient, cleansing the genitals or breasts.

Diet.—*First 48 hours.*—Milk (1½ to 2 pints a day), gruel, soup, one cup of tea a day, toast and butter.

Second 48 hours.—Milk toast, poached eggs, porridge, soup, cornstarch, tapioca, wine-jelly, small raw or stewed oysters, one cup of coffee or tea a day.

Third 48 hours.—Soup, white meat of fowl, mashed potatoes, beets, in addition to above.

After sixth day, return cautiously to ordinary diet,—that is, three meals a day, meat at one of them, of an easily digested character,—white meat of fowl, tenderloin of beef, etc.,—and a glass of milk at least three times a day, between meals and before going to sleep at night; also a glass in the middle of the night.

Child.—After being well rubbed with sweet-oil, the child is to be washed on the nurse's lap. The bath-tub may be used by the end of the first week. Water not over 100° F.

The cord is to be dressed with salicylated cotton. Observe carefully for bleeding. A good dusting-powder for the navel is salicylic acid 1 part, starch 5 parts.

The child should be bathed daily, about midday, in the warmest part of the room. Use Castile soap and a soft sponge; avoid the eyes.

Diapers changed often enough. For chafe, use cold cream and talcum powder.

Nursing.—The child is to be put to the breast every four hours for the first two days. *No other food is to be given it.* After the second day it should be nursed every two hours, from 7 A. M. to 9 P. M., and twice during the night (1 A. M. and 5 A. M.). After every nursing the nipples are to be carefully dried and then smeared with a little sweet-oil for the first week or two, applied with fresh pledgets of absorbent cotton.

The Final Examination at the End of the Puerperium.—The recently delivered woman should be subjected to three careful examinations: The first shortly after labor, or as soon as it is convenient, to detect the injuries of child-birth; the second before she leaves her room, to determine the position of the uterus; and the third at the end of six weeks after delivery. The final examination should be conducted in a methodical manner, as follows:

The Inspection of the Vulva.—As a woman lies on an examining table or across the bed with her thighs separated, the labia majora should be in close apposition, closing the vulvar orifice and concealing the vaginal entrance. A gaping vulvar orifice and vaginal introitus indicate subinvolution of the vagina, overstretching of the tissues, and injury of the perineal center or body.

By placing the thumbs on either side of the labia and stretching them apart a view of the lower third of the vaginal canal is

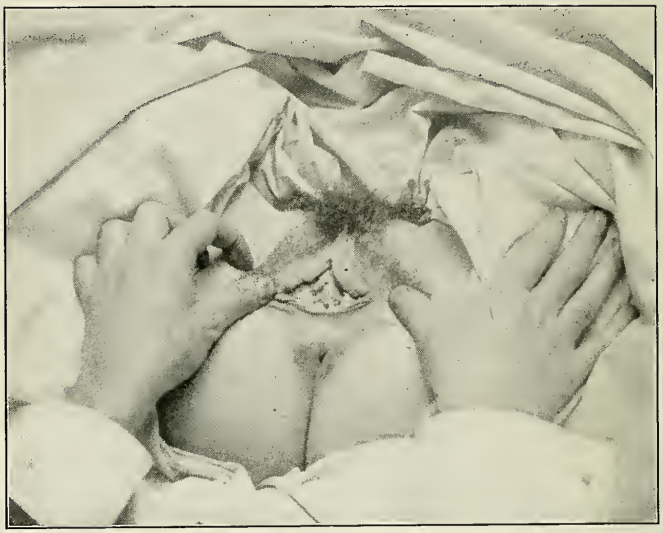


Fig. 237.—Perfect preservation of the vulvar orifice and pelvic floor in a primipara, six weeks after labor.

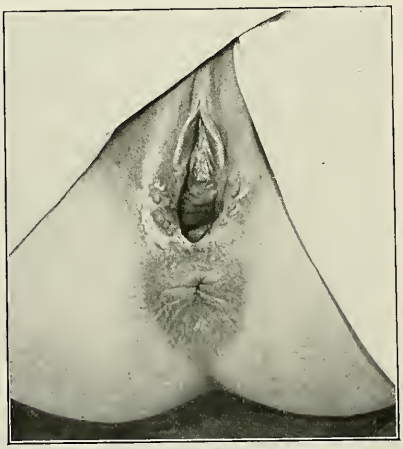


Fig. 238.—Gaping vulvar orifice from injury to the perineal body, retraction of the ends of the transversus perinei and bulbo-cavernosus muscle, overstretching and subinvolution of the vagina.

Fig. 239.—Gaping vulvar orifice, injury of urogenital trigonum muscle, and prolapse of lower anterior vaginal wall.

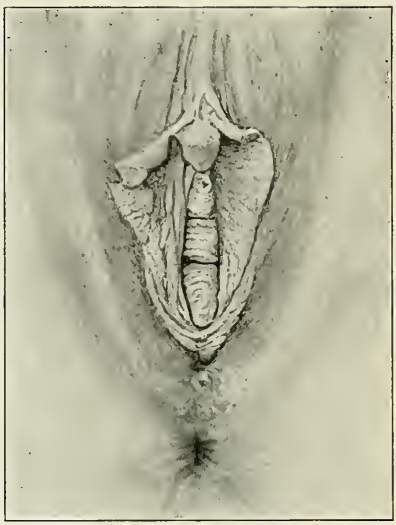


Fig. 240.—Gaping vulvar orifice with rectocele and cystocele from a former labor.

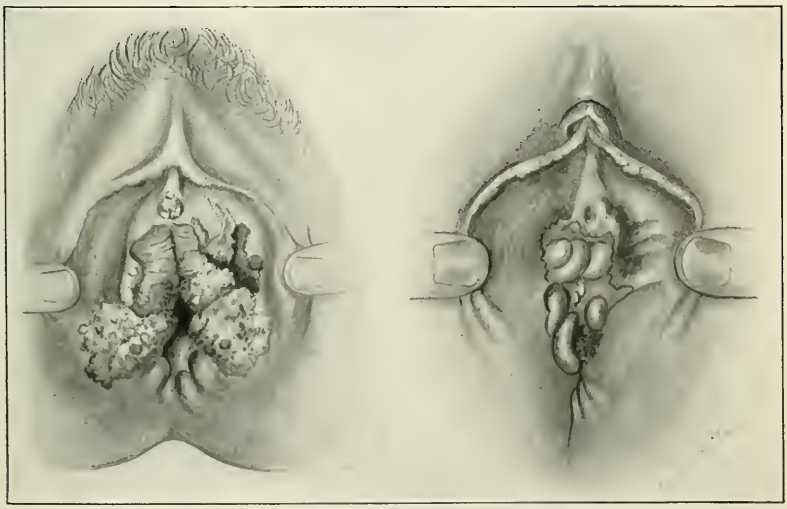


Fig. 241.—Complete tear of the perineum directly after labor.

Fig. 242.—Same patient six weeks later, before operation, which had been postponed on account of albuminuria and infection.

obtained; injuries in the posterior sulci to the levatores ani muscles are visible; lacerations of the anterior sulci manifest themselves by a dropping of the lower anterior vaginal wall downward and forward, making a pouch of mucous membrane filling the distended vaginal entrance. This is the injury which later, if not repaired, results in cystocele.

If there is a complete tear of the perineum through the sphincter, it should immediately be detected on inspection, or certainly when the labia are separated. If there is any doubt about it, the forefinger of the left hand, protected by a finger-cot, in the rectum, and the thumb in the vagina determine the thickness of the tissues between the two.

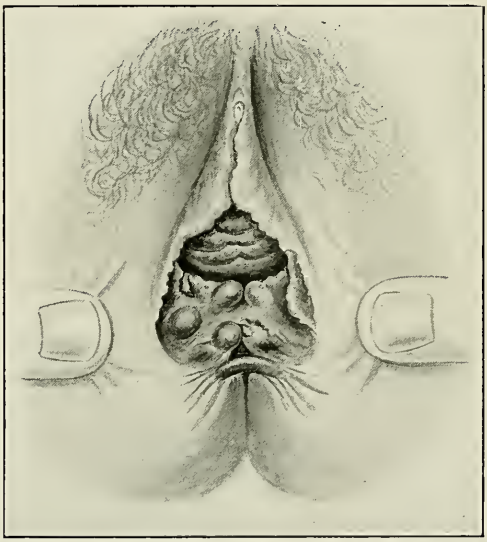


Fig. 243.—Complete tear of the perineum six weeks after labor; sphincter muscle masked by large hemorrhoidal vein.

The Digital Examination of the Vagina (Indagation).—First injury and retraction of the transversus perinei muscles is detected by the tip of the forefinger as shown in Fig. 244. Next, the integrity of the levatores ani muscles is tested as follows: The forefinger of the left hand is inserted to the second joint; pressure is made in each posterior sulcus downward and outward toward the tuber ischii; if the muscle is lacerated, the finger sinks into a deep cleft almost or quite to the bony pelvic wall. The forefinger is then swept over the posterior vaginal wall from one descending ramus of the pubis to the other; if the levator ani is injured on either side, the cleft in it is plainly felt. Both forefingers are in-

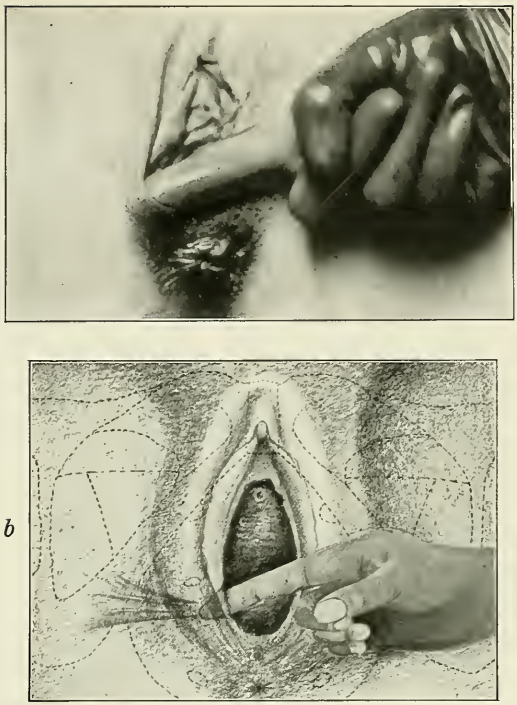


Fig. 244.—Palpation of pouch due to laceration and retraction of the transversus perinei muscle: *a*, Photograph from nature; *b*, diagrammatic sketch.

Fig. 245.—Testing the levator ani muscle in the right posterior vaginal sulcus. In this case there was a deep tear.

serted in the posterior sulci; pressure is made outward and downward. The levator ani is palpated between the thumb and forefinger; one being inside the vagina, the other upon the labium. Next, the integrity of the urogenital trigonum muscle[1] and fascia is tested by pressing the forefinger into each anterior sulcus upward against the lower edge of the pubic bone. A muscular cushion is felt in the normal case. If there is a submucous laceration of the muscle, the finger comes in close contact with the sharp edge of the bone. The left anterior sulcus is usually the site of injury, as the long diameter of the fetal skull almost always lies in the right oblique diameter of the maternal pelvis. The finger is now inserted more deeply in the vagina to feel the cervix in order to detect the kind and degree of injury it may have suffered. The direction of the cervix is of no importance in diagnosticating uterine position; it may look forward in anteflexion and backward in retroflexion.

The position of the uterus is next investigated—of all single items of information in this examination, the most important. A combined examination is necessary. If the corpus uteri can be grasped between the finger or fingers in the anterior vaginal vault and the fingers of the other hand upon the hypogastrium, and the fundus points sufficiently far forward for the weight of the intra-abdominal contents to rest upon the posterior uterine wall, the uterus is in satisfactory position. If it is impossible to take this bimanual grip of the uterus, the internal fingers are shifted to the posterior vaginal vault, and if there is a retroflexion, the corpus uteri is easily traced backward toward the sacrum and the angle of flexion is plainly felt in the lower uterine segment. Pressure from above through the abdominal wall facilitates the palpation of the retroflexed uterus.

During the bimanual examination the size and consistency of the uterus are noted to determine the degree of involution.

Finally, the broad ligaments, the tubes and ovaries, and the utero-sacral ligaments are palpated by a combined examination to detect inflammatory swelling, displacements, fixation, and peritoneal or cellulitic exudate.

The specular examination of the vagina and cervix follows the digital examination to detect ulcerations of the vagina or injuries in its upper part, and particularly to determine the kind and degree of injuries to the cervix, the existence of eversion and erosion of the lips. A bivalve speculum (Collins) is most con-

[1] For the best description of this muscle the student is referred to Waldeyer's "Das Becken." It runs across the anterior vaginal wall from one ischiopubic junction to the other. It is the only muscle actually inserted into the vagina, and is the strongest support of the lower anterior vaginal wall; its laceration, which frequently occurs in labor, is the first step in the formation of a cystocele.

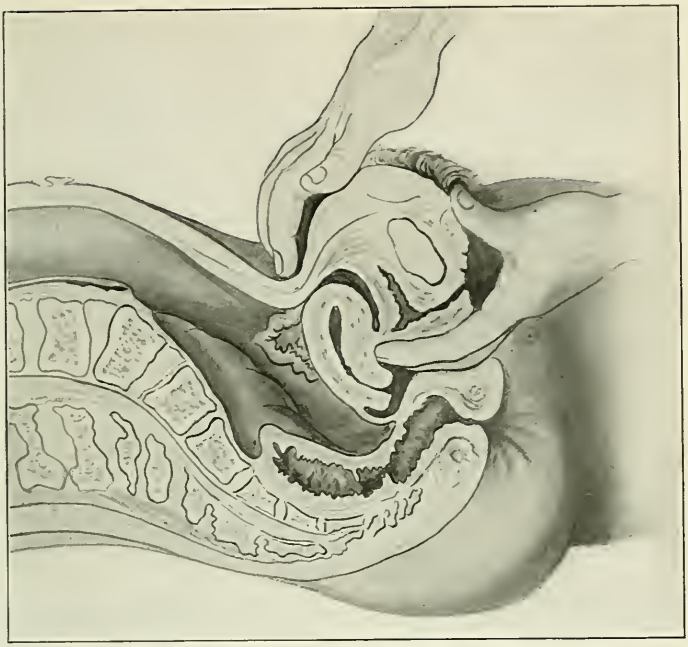


Fig. 246.—Examining the position of the uterus.

Fig. 247.—Protrusion between gaping recti muscles of coils of intestines, in which peristalsis could be seen.

venient to examine the cervix. The author's skeleton bivalve speculum gives the best view of the vaginal walls.

Fig. 248.—Pyramidal elevation of the abdomen when the woman strained.

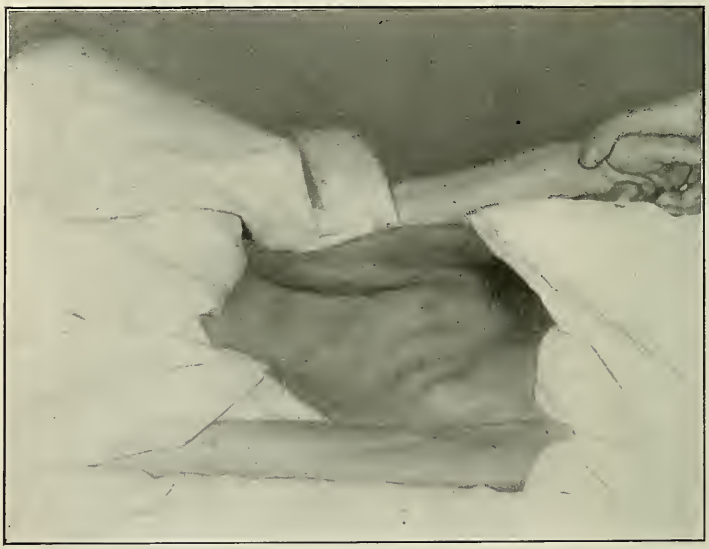


Fig. 249.—Retraction instead of protrusion of the abdominal wall between the recti muscles when the patient attempts to rise to a sitting posture.

The abdominal wall is palpated and inspected to test its tonicity, and particularly to detect a diastasis of the recti muscles. The

separation of the latter is measured by sinking the outspread finger-tips o ne hand crosswise between the muscles. If there is doubt as to the degree of separation, while the fingers are held in position, the physician helps the patient to rise to a sitting posture by grasping her hand. In a normal case the muscles are

Fig. 250.—Testing the separation of the recti muscles.

approximated as the patient rises. If there is diastasis, the degree of separation is evident, as the muscles are clearly outlined when they contract. By inspection, protrusion of intestines can be seen in extreme cases. If the woman strains, the abdominal wall is thrown outward in a wedge shape between the muscles. Rarely it is retracted instead of protruded.

The kidneys are palpated to determine their position and mobility. The woman sits bolt upright, her back and head supported, her arms hanging down limp alongside of her, and all her muscles relaxed as much as possible. The outspread fingers of the physician's hands grasp the kidney through the anterior and the posterior abdominal walls. If the kidney is in good position, the fingers of the anterior hand must be inserted under the floating ribs. Another method is to examine the patient on her feet, the trunk flexed and the arms supported on the back of a chair (Fig. 251).

The coccyx is examined to detect injury of its joints as illustrated in Fig. 252, the woman being placed in Sims' position and the physician's forefinger protected by a rubber finger-cot.

Fig. 251.—Palpation of a floating kidney in the erect posture.

Fig. 252.—Examination of the coccyx.

It is only by such a methodical and thorough examination that the physician avoids overlooking the ill consequences of labor. The invalidism of women following child-birth could be enormously reduced, a reproach to medicine could be removed, if this plan were uniformly adopted.

There is no valid excuse for a rectocele, injured cervix with all its consequences, including cancer, cystocele, uterine displacements of puerperal origin, including prolapse, subinvolution, and endometritis following child-birth, coccygodynia from a ruptured joint in labor, pendulous belly with ptosis of the abdominal viscera from a relaxed abdominal wall, and diastasis of the recti muscles. All the injuries of child-birth, including those of the cervix and of the anterior vaginal wall, can be successfully repaired during the puerperium by an intermediate or by a secondary operation, instead of allowing the woman to endure years of suffering and invalidism with such impairment of physical and nervous strength that she can never be restored to her original health.

Every one of the conditions enumerated above is amenable to appropriate treatment, and none of them should be allowed to become chronic.

PART III.

THE MECHANISM OF LABOR.

THE mechanism[1] of labor is the manner in which a fetus and its appendages traverse the birth-canal and are expelled. It takes into account the complicated structure of the maternal and fetal parts, considering their movements and the mechanisms of their motions.

It is necessary to define, further, certain terms that will be used constantly in the study of the mechanism of labor.

By **presentation** is meant that part of the fetal body which presents itself to the examining finger in the center of the plane of the superior strait.

The term **position** may be applied to the position of the child *in utero*, whether it is longitudinal, oblique, or transverse; or, in another sense, it is the varying relations which the presenting part of the fetus bears to the surrounding maternal structures at the plane of the superior strait.

The presentation and position of the fetus are determined by abdominal palpation, by auscultation, and by vaginal examination.

Abdominal Palpation.—For this kind of obstetrical examination the woman should be placed on her back, with the abdomen exposed. The examiner, standing to one side of the patient, by a series of stroking, patting, and rubbing motions with his hands, determines the height of the fundus uteri, the tension of the abdominal walls, the irritability of the uterus, the quantity of liquor amnii, the size of the fetus, its position, and its presentation. It has been claimed that in favorable cases the placenta can be felt, and that its position can thus be diagnosticated (Spencer). It is further asserted that if the greater bulk of the uterus is anterior to the insertion of the tubes, the placenta is anterior, and vice versâ (Leopold).

[1] From the Greek μηχανή, contrivance, machine (from root μῆχος, a manner, a way, a means).

The Diagnosis of Fetal Position and Presentation by Abdominal Palpation.—The examiner stands alongside the patient, facing her head; the tips of the fingers of both hands, moving together and at equal distances from the middle line, are carried up the sides of the abdomen by a series of tapping movements; and upon one side (for example, the left, in the L. O. A. position) is

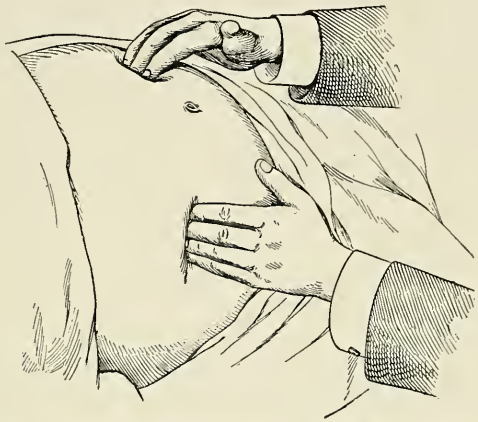


Fig. 253.—Abdominal palpation: locating the fetal back.

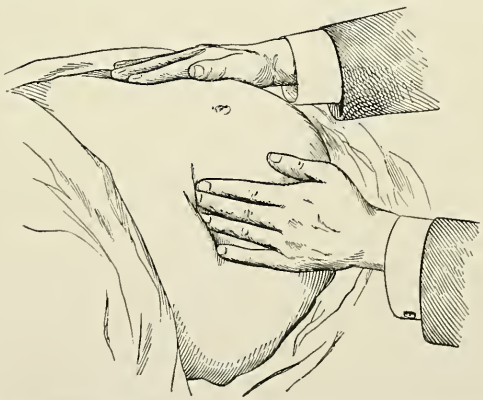


Fig. 254.—Abdominal palpation: finding the lower extremities of the fetus.

noticed a firm, broad, even sense of resistance, contrasting with the cystic, tumor-like sensation of the other side, with the occasional encounter of firm, irregular bodies,—the fetal extremities.

This firm, broad, even resistance is produced by the fetal back, and, to confirm this fact, the extremities are felt for by a rubbing motion with one outstretched hand on the opposite

side. They are felt as cylindrical, irregular bodies, slipping away from the hand, and changing their position from time to time. Having located the back and the extremities, the portion of the fetal ellipse presenting at the superior strait is next ascertained.

The examiner now faces the woman's feet, and, with the outstretched hands, the fingers parallel with and the middle finger over the center of Poupart's ligament, on either side, the fingers dip down beneath the ligament into the pelvic cavity. If the head is presenting, it is felt as a hard, regular, round body, the greater mass of the occiput, the sharp point of the chin, and the groove between occiput and back being often distinguishable. At the same time, the density of the head, its compressibility, its approximate size, and its relative size to the pelvis may be learned.

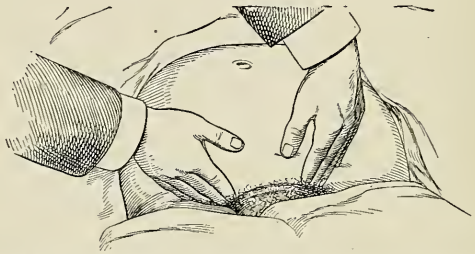


Fig. 255.—Abdominal palpation: locating the fetal head.

By **auscultation** the fetal heart-sounds are located, and their rate and intensity are noted. The uterine bruit and the funic souffle are often heard. The former is a low-pitched musical murmur synchronous with the maternal heart-beat. The latter is a high-pitched whistling murmur synchronous with the fetal heart-beat. The position on the abdomen at which the fetal heart-sounds are heard with greatest intensity is of diagnostic value in confirming the find, by abdominal palpation, as to position and presentation.

By **vaginal examination** the finger detects the varying portions of the fetal body which may present at the superior strait, as the cranium, the face, the shoulder, the buttocks, the knees, feet, and, exceptionally, the elbow or hand.

The position of the fetus *in utero* is longitudinal in 99½ per cent. of all cases. The cephalic extremity presents in about 95½ per cent., 95 per cent. being vertex presentations. In about one-half of 1 per cent. of cases the face presents; the brow very rarely. In about 3 per cent. of all cases the breech

presents, and in about one-half of 1 per cent. the fetus occupies a transverse position *in utero.*

An explanation of the great frequency of cephalic presentations is found in a voluntary assumption of that position by the fetus, because it affords it the greatest degree of comfort and the best opportunity for growth and development, the largest room being found in the fundus uteri for the lower extremities, which are freely moved and exercised.[1]

An explanation of the great frequency of presentations of the vertex is afforded by the mechanical arrangement of the connection between fetal head and body, diagrammatically represented by two bars attached to each other,—that representing the head joined to that representing the spinal column, not at its middle, but at a point nearer one end of the bar (Fig. 256). An equal force exerted upon both ends of the lever represented by the child's head will result in the greater flexion of the longer bar, which is that portion of the fetal skull in front of spinal column.

Fig. 256.—Diagram illustrating the cause of the frequency of vertex presentations.

The positions of the various presentations are named by the relationship which the most prominent anatomical feature of the presenting part bears to the acetabula or to the sacro-iliac junctions of the maternal pelvis. They are, therefore, four in number.

Positions of Vertex Presentations.—1. L. O. A., left occipito-anterior, the occiput looking to the left acetabulum. 2. R. O. A., right occipito-anterior. 3. R. O. P., right occipitoposterior, the occiput looking to the right sacro-iliac joint. 4. L. O. P., left occipitoposterior. Of all vertex presentations about seventy per cent. are L. O. A., thirty per cent. R. O. P. The long axis of the fetal skull very rarely lies in the left oblique diameter of the maternal pelvis.

Explanation of the Frequency of L. O. A. and R. O. P.—The position of the rectum shortens the left oblique diameter of the pelvis; therefore the long diameter of the head, seeking the direction of least resistance, adjusts itself in the right oblique

[1] It is probable that other factors often enter into the assumption of a cephalic presentation by the fetus. The fact that the cephalic extremity is the heavier, and so falls toward the pelvis as the woman stands erect, and the growth of the uterus in a perpendicular rather than a lateral direction, forcing the long axis of the fetus to coincide with the long axis of the uterus, are no doubt instrumental in determining a cephalic rather than a pelvic presentation; but if one accepts this explanation unreservedly, he could not explain a breech presentation at all, nor could he account for the return of a fetus to a breech presentation after it had been turned by external version. Sir James Y. Simpson's theory, therefore, given in the text is, on the whole, the most satisfactory.

diameter of the pelvis and the projection of the lumbar spinal column, to which the fetus by choice adapts its anterior concave surface, usually results in the back being turned forward and tilted a little toward the right, because of the usual right lateral version of the pregnant uterus. Thus, the left occipito-anterior position of the vertex is the commonest position in labor. Should the child's back be directed to the right, the occiput is turned posteriorly, because the chin would be pushed forward by the sigmoid flexure and rectum, this being a stronger force in the arrangement of the head than the child's inclination to adapt its concave abdominal surface to the convex surface of the maternal lumbar spine.

THE FORCES INVOLVED IN THE MECHANISM OF LABOR.

There are certain forces operative in every labor irrespective of fetal presentation and position. These are the **forces of expulsion** contributed by the uterine muscle and the abdominal muscles, and the **forces of resistance** contributed by the lower uterine segment, the cervix, vagina, vulva, the pelvis, and the fetal body.

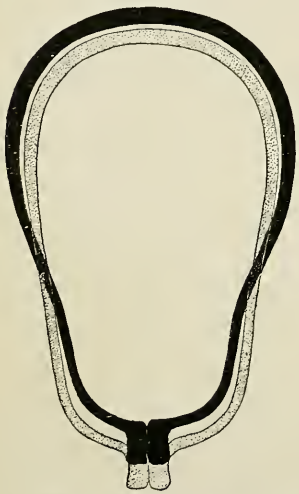
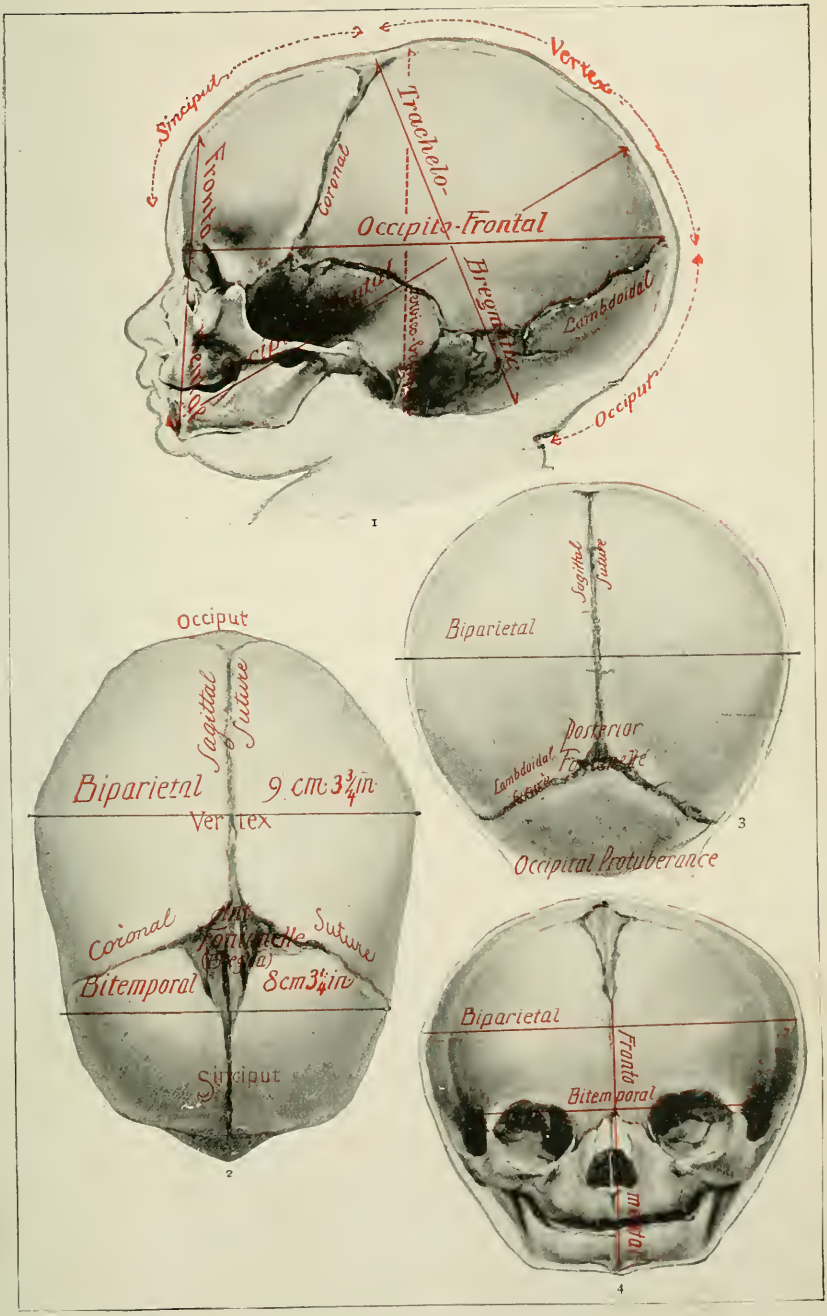


Fig. 257.—Diagram showing the diminution of the upper uterine segment and the expansion of the lower segment during each contraction.

The forces of expulsion are furnished by a great part of the uterine muscle (the upper uterine segment) and by the muscular action of the abdominal wall. That portion of the uterine canal which must be dilated to allow the escape of the fetus is called the *lower uterine segment.* Its boundaries are: above, the firm attachment of the peritoneum to the uterine wall, and, below, the internal os. That portion of the uterine wall above the point at which the dilatation of the uterine cavity begins is called the *upper uterine segment;* the boundary-line between these segments, often marked by a perceptible ridge, especially in obstructed labors, is called the *contraction ring*, or the ring of Bandl.



Fetal skull seen (1) from the side, (2) from above, (3) from behind, and (4) from in front, showing sutures, fontanels, and diameters (Dickinson).

The manner in which the uterine muscle exerts its force upon the fetal body is by a diminution of the intra-uterine area. The uterine muscle in contraction somewhat increases the longitudinal diameter of the uterus, but decidedly diminishes the transverse and anteroposterior diameters. The contraction of the abdominal muscles likewise diminishes the area of intra-abdominal space. The degree of force exerted by the combined action of uterine and abdominal walls has been estimated to be from seventeen to fifty-five pounds. The forces of resistance are furnished by that portion of the parturient tract which must be dilated,—*i. e.*, from the contraction ring to the vulva, including **the lower uterine segment, the cervix, the vagina, and the vulva.** The dilatation of the cervix is effected, if the membranes are preserved, by the displacement of the most easily displaceable of the uterine contents, the liquor amnii, in

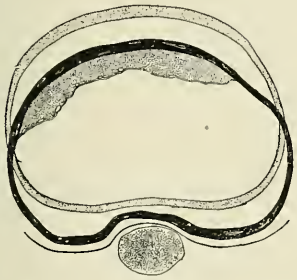


Fig. 258.—Diagram illustrating alteration in shape of a cross-section of a uterus during its contractions. The heavy line represents the non-contracted, the dotted line the contracted uterus (compare Fig. 259) (Dickinson).

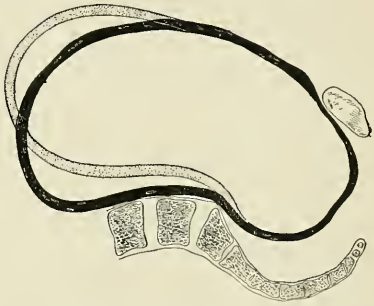


Fig. 259.—Diagram illustrating the alteration in the shape of a sagittal section of the uterus during its contractions. The heavy line represents the non-contracted, the dotted line the contracted uterus (Dickinson).

the direction of least resistance,—through the cervical canal. A pouch of the membranes insinuated in the canal subjects the surrounding ring of cervical muscle to water-pressure, equally exerted in all directions, but felt by the cervix only in a lateral or horizontal direction. If the membranes are ruptured and the presenting part impinges directly on the cervix and lower uterine segment, the former is subjected to a lateral pull from all sides at once, as the presenting part pushes from above downward. The presenting part, moreover, whatever it be, is somewhat conical in form, and subjects the cervix to a lateral push as it is wedged into the cervical canal (Fig. 260). The dilatation of the lower uterine segment and of the cervix is not, however, simply mechanical, the serous infiltration of the lymph-spaces and the

separation of the muscle-fibers lessening the power of resistance gained by cohesion of muscle-bundles.

The dilatation of both the lower uterine segment and the cervical canal is also assisted by the longitudinal muscle-fibers in these regions drawing the cervix up over the presenting part. Finally, the circular muscle of the cervix, subjected to the strain of constant push and pull, becomes fatigued and, at length, paralyzed. Below the cervix dilatation is effected mainly by the mechanical stretching of the walls of the birth-canal.

The bony walls of the pelvis, in a normal case, only offer enough resistance to delay the progress of the presenting part sufficiently to insure a gradual dilatation of the soft, resisting structures.

The Fetal Body.—The head is by far the most important anatomical division of the fetal body in labor, on account of its bulk and density. The fetal head may be divided into the yielding and the unyielding portions. The former consists of the cranium, composed of the two frontal, the two temporal, the

Fig. 260.—Diagrams illustrating the lateral "pull" and "push" on the cervix.

two parietal, and the occipital bones. These bones are separated from each other as follows: The two frontals by the frontal suture, the frontal from the parietal by the coronal suture, the two parietal by the sagittal suture, and the two parietal from the occipital by the lambdoidal suture. At the junction of the lambdoidal and the sagittal sutures there is a membranous space, called the posterior fontanel, triangular in shape. At the junction of the frontal, coronal, and sagittal sutures there is also a membranous space, called the anterior fontanel, kite-shaped, and larger than the posterior fontanel. This portion of the skull, the cranium, yields to pressure, and is reduced in size by an overlapping of the bones.

The unyielding portion of the skull comprises the face and the base of the skull. The bones of this region are fixed and unyielding.

A transverse vertical section of the skull is somewhat wedge-shaped, the wedge tapering toward the neck. A longitudinal medial section is distinctly conical in form.

Possible Presentations of the Head.—*Vertex.*—By this term is meant that conical portion of the skull with its apex at the smaller fontanel and its base at the planes of the biparietal and trachelobregmatic diameters,—*the face; the brow; the larger fontanel; the parietal eminence; the ear.*

THE MECHANISM OF THE SEVERAL PRESENTATIONS AND POSITIONS.

The Mechanism of Labor in a Vertex Presentation and a Left Occipito-anterior Position.—It is convenient to begin the study of each presentation with a consideration of its diagnosis.

The diagnosis of position and presentation is made by abdominal palpation, auscultation, and vaginal examination. By these

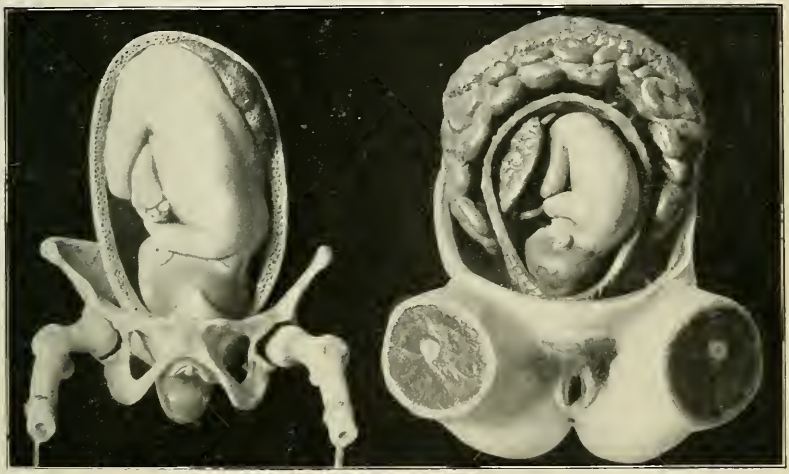


Fig. 261.—Left occipito-anterior position of a vertex presentation.

methods of examination in the position and presentation under discussion the fetal back is found to the left, the extremities to the right and above, the head below; the heart-sounds are heard most distinctly about an inch below and to the left of the umbilicus; the examining finger in the vagina detects the vertex presenting, with the occiput directed toward the left acetabulum; the sagittal suture is in the right oblique diameter of pelvis; the smaller fontanel, recognized by the junction of the lambdoidal and the sagittal sutures, is the most dependent portion of the presenting part; the tip of the occipital bone is overlapped by the parietal bones. As the direction or axis of the pelvic canal diverges from that of the uterine cavity, running, at first, more

posteriorly, there is usually a lateral inclination of the head so that the sagittal suture is posterior to the normal position of the oblique diameter of the pelvis, and one parietal bone (the anterior) is deeper in the pelvis than the other one.

The mechanism of labor in a left occipito-anterior position of a vertex presentation may be taken as a type of the mechanism of all labors, the variations in the process imposed upon it by

Fig. 262.—Vertex presentation, left occipito-anterior position.

the different positions and presentations of the fetus being readily understood if the typical mechanism of the commonest presentation and position is thoroughly mastered.

It is convenient to divide the mechanism of labor into a number of steps or acts, as follows :

First Step.—Accommodation of the size of the fetal skull to the size of the pelvic canal by flexion ; accommodation of the shape of the fetal skull to the shape of the pelvic inlet by molding ; accommodation of the direction of the head to the direction of

the pelvic canal by lateral inclination. These movements occur prior to labor, when the head enters the pelvic inlet with the subsidence of the uterus.

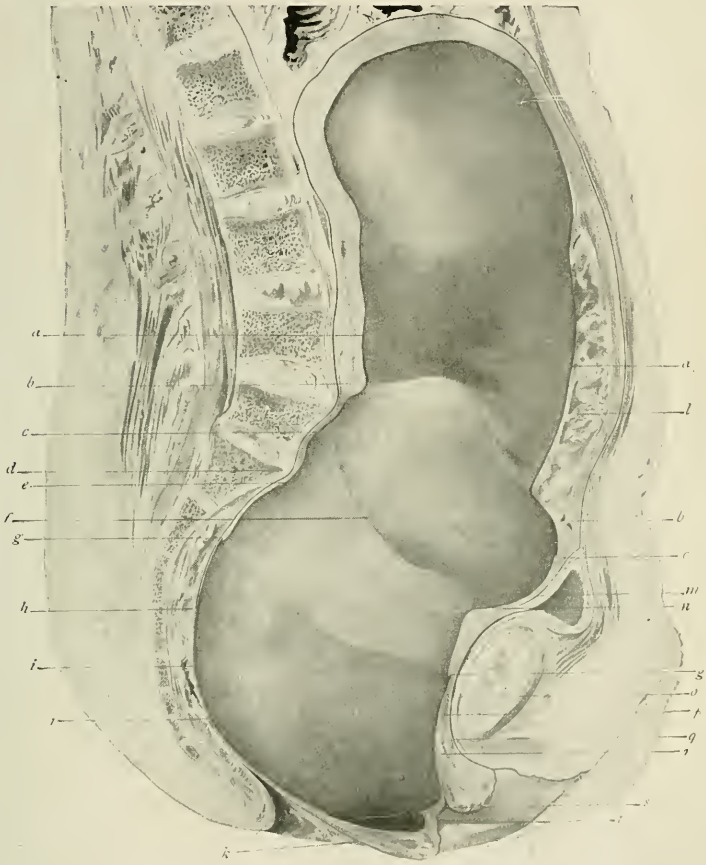


Fig. 263.—Genital tract with fetus removed, showing divergence of the pelvic axis from that of the uterine cavity: *a*, *a*, Membranes; *b*, *b*, contraction ring; *c*, *c*, point down to which membranes are unseparated; *d*, promontory; *e*, region of os internum (above which fragments of decidua are found, and below it cervical glands); *f*, bulging of wall into neck of fetus; *g*, *g*, os externum; *h*, pouch of Douglas; *i*, posterior vaginal wall (elongated and thinned); *j*, rectum; *k*, stretched anal canal; *l*, placenta; *m*, uterovesical peritoneum; *n*, region of os internum (above which fragments of membranes are found, and below it portions of cervical glands); *o*, lower limit of bladder; *p*, anterior vaginal wall (not elongated); *q*, urethra; *r*, vagina; *s*, vulva; *t*, perineum with blood extravasation (Barbour and Webster).

Second Step.—Further flexion, molding, and accommodation of the head to the pelvis by lateral inclination, when labor-pains appear, and the head is subjected to a propulsive force and to the resistance of the lower uterine segment, the cervix, and the pelvic walls.

Third Step.—Dilatation of the lower uterine cavity and of the cervical canal.

Fourth Step.—Descent of the head to the pelvic floor, mainly by an extension of the fetal spine. The fetal body, as a whole, is not yet propelled along the birth-canal, because, during a pain and while the head is obviously descending to the pelvic floor, the fundus uteri and the breech do not sink to a lower level. On the contrary, there is a slight elevation of the fundus, an

Fig. 264.—The descent of the head in a vertex presentation, left occipito-anterior position.

elongation of the uterus, and the distance between the head and the breech increases during a uterine contraction.

Fifth Step.—Anterior rotation of the occiput.

The Cause of This Movement.—The most dependent portion of the head, the tip of the occiput, driven through the funnel-shaped parturient canal, first strikes the resistance of the upper portion of the pelvic floor, which is represented by a curved line or plane running inward, downward, and forward. These directions are imposed, therefore, upon any movable body impinging upon the pelvic floor and impelled by a force from above. The occiput can only travel in the directions named by a rotary movement of the head upon the spine. The pelvic canal is a spiral canal making half a turn in its course. The wall of each half of the

pelvic canal might be represented by innumerable spiral lines crossing one another from behind forward and from before backward. But the lines running from behind forward are much bolder and more pronounced in their curve than those running from before backward; hence, any body encountering the resistance of the pelvic wall or floor is impelled to take a direction by preference downward, forward, and inward; if, however, there should be an insuperable obstacle to movement in these directions,

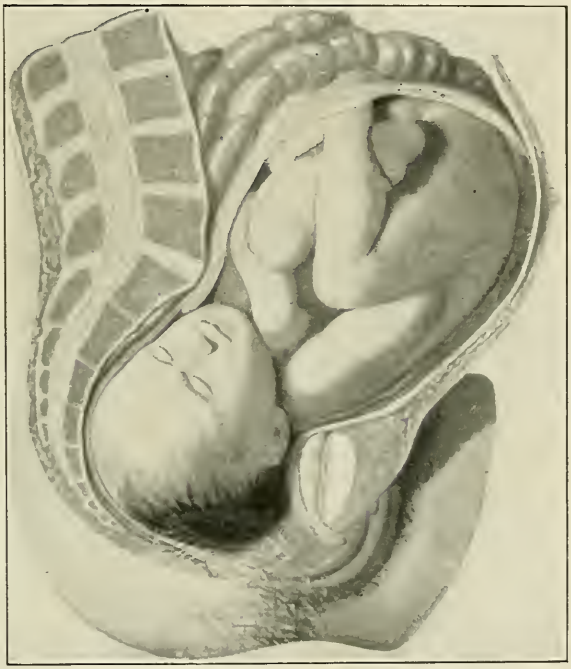


Fig. 265.—The descent of the head in a vertex presentation, left occipito-anterior position.

the course of the more feebly marked lines is followed—namely, downward, inward, and backward. Anterior rotation of the presenting part is therefore the rule; posterior rotation, even from an anterior position, is the exception, but is possible.

Sixth Step.—Propulsion and extension of the head in the direction of least resistance under the pubic arch until it is delivered, again following the direction of the lower pelvic floor, which is now upward, forward, and outward.

Seventh Step.—Restitution. The rotary movement of the head, previously described, is not followed by the shoulders. As the former escapes from the vulva with the sagittal suture running

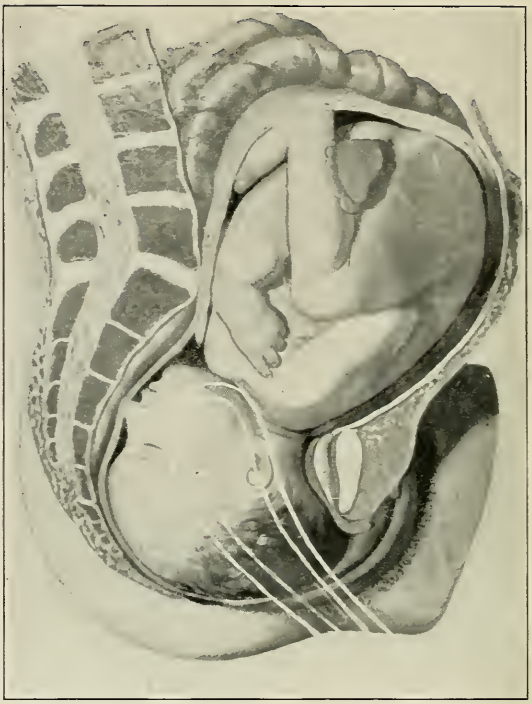


Fig. 266.—The rotation of the head being completed, its propulsion forward and outward begins.

Fig. 267.—The passage of the head over the perineum.

anteroposteriorly, the neck is necessarily twisted. As soon as the head is released from the forces which compel its rotation, it imme-

diately resumes its natural relationship with the shoulders, which lie with their long axis in the oblique diameter of the pelvis.

Eighth Step.—External rotation. This movement of the head is explained by the movement of the shoulders within the birth-canal.

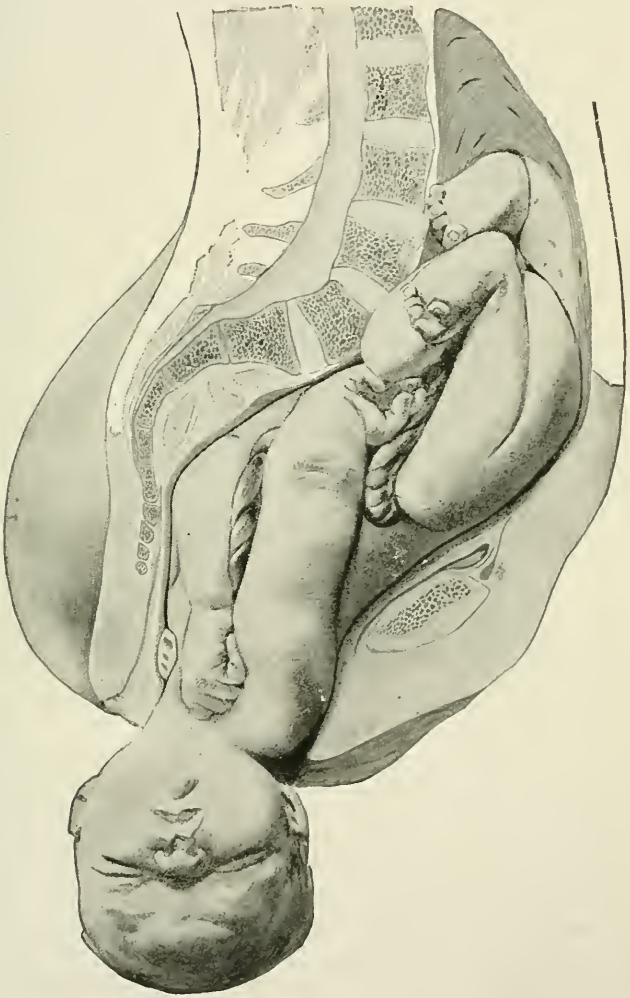


Fig. 268.—Birth of the shoulders. Frozen section (Zweifel).

Ninth Step.—Descent, rotation, and birth of shoulders.

The anterior, or right, shoulder first strikes the resistance of the pelvic floor. In obedience to the universal law already

enunciated, that whatever portion of the fetal body first encounters this resistance is directed downward, forward, and inward, the anterior shoulder is compelled to travel in these directions by a rotary movement of the shoulders on the spine.

The anterior shoulder finally appears under the arch of the symphysis; unable to move further forward, the posterior shoulder and arm are propelled over the floor of the pelvis and are born, their escape being followed by the birth of the anterior shoulder and arm.

Tenth Step.—Delivery of remainder of the body by a movement so rapid that the eye can not well follow it, the birth-canal being so widely dilated that its walls offer no resistance to the escape of the small and compressible thorax, abdomen, and lower extremities.

ABNORMALITIES IN MECHANISM AND THEIR MANAGEMENT.

Abnormalities of Flexion at the Inlet.—Imperfect Vertical Flexion in a Flat Pelvis.—This action is conservative on the part of nature, and has the effect of bringing the small bitemporal diameter (8 cm.—3 ¼ in.) in relation with the contracted conjugate. Associated with this abnormality are found anomalies of position and lateral flexion. The head lies transversely, the sagittal suture running in the transverse diameter of the pelvis, and the lateral flexion is exaggerated as the result of the increased obliquity of the pelvis, the increase of the conjugatosymphyseal angle and the posterior parietal bone catching on the promontory. The exaggerated lateral inclination of the head is accompanied by overlapping of the right (anterior) parietal bone. In much exaggerated lateral flexion the anterior parietal bone, or even the ear, may present. In exceptional cases (one-tenth) the posterior parietal bone may present in consequence of the anterior portion of the head catching upon the pubic spines. These anomalies of mechanism require no treatment, as a rule. They should not, indeed, be interfered with, as only by these means is the obstacle of a contracted pelvis to be obviated spontaneously. It is, however, occasionally necessary to interfere on account of exaggerated lateral inclination. A presentation of one ear may demand podalic version. A less exaggerated lateral inclination, especially in case the anterior parietal bone catches on the pubis, is ordinarily easily dealt with by using one blade of the forceps as a vectis to pry down the retarded half of the head. It is sometimes possible to secure spontaneous engagement by exaggerating lateral inclination; for this purpose one blade of the forceps is used to pry still further down the lower half of the head.

Anomalies of Direction.—In anterior displacements of the parturient uterus with a pendulous belly there is an abnormal backward direction of the presenting part, or a direction even upward and backward, and in lateral tilting of the uterus the presenting part is propelled against the opposite wall of the pelvic inlet and canal. All progress may cease as the head butts in vain against the unyielding bony walls. An abdominal binder corrects the anterior displacements. Placing a woman on the side toward which the fundus uteri is tilted and putting under her flank a rolled blanket or pillow corrects the lateral displacement.

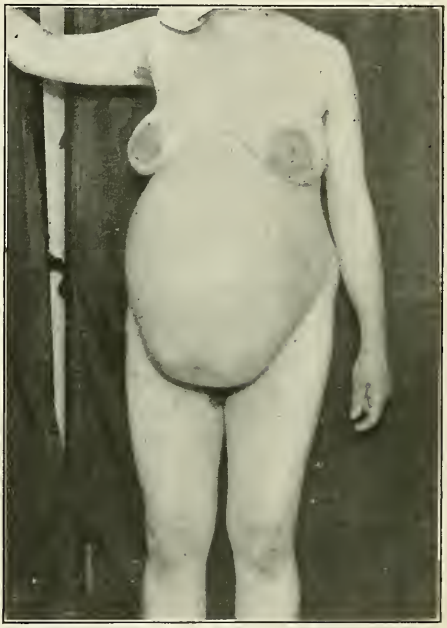


Fig. 269.—Pendulous belly.

Anomalies of Rotation.—There may be abnormal weakness in resistance or propulsion, resulting in incomplete rotation. Anomalies of rotation are more important in cases of posterior positions of the occiput.

Anomalies in Vertical Flexion at the Pelvic Outlet.—Flexion may be incomplete if the head does not encounter normal resistance in the pelvic cavity or upon the pelvic floor, or it may be exaggerated, in which case the vertex impinges on the center of the perineum and may perforate it. Both of these anomalies may be corrected by applying the forceps and lowering the handles for incomplete, raising them for overflexion, as the woman lies upon her back.

Anomalies of Extension and Forward Propulsion.—Failure of extension and of a forward propulsion of the head under the pubic arch occurs as the result of weakness of the pelvic floor, in consequence of destruction of the levatores ani muscles in a former labor. Paradoxical, therefore, as it may sound, a laceration of the pelvic floor in one labor may predispose to further lacerations in the next.

Anomalies of Restitution.—This movement is more or less theoretical and is rarely perfectly performed. It fails altogether if the neck is a long time twisted or is tightly gripped by the ring of the vulvar orifice.

Anomalies of external rotation are due to an imperfect or anomalous rotation of the shoulders. They are of frequent occurrence.

Anomalous Descent and Rotation of Shoulders.—Rarely the anterior shoulder is caught at the pelvic brim and does not descend. The posterior shoulder is then the first portion of this part of the fetal body to encounter the resistance of the pelvic floor. It is consequently turned forward, inward, and downward, the head externally following this movement and turning unexpectedly with the face to the *left* and the occiput to the *right*, though it had descended the birth-canal and escaped from the parturient outlet in a left occipito-anterior position.

Mechanism of a Right Occipito-anterior Position of a Vertex Presentation.—Diagnosis.—Palpation reveals the back to the right anteriorly; the extremities to the left above; the head below. The heart-sounds are heard near the median line, below the umbilicus. Digital examination shows the small fontanel toward the right acetabulum; the sagittal suture in the left oblique diameter of the pelvis.

The mechanism of this position does not differ from the mechanism of the L. O. A., except in that the occiput being directed toward the right acetabulum, the rotation of the head and face takes the opposite direction,—that is, the occiput rotates anteriorly, moving from right to left.

The Mechanism of Posterior Positions of a Vertex Presentation, R. O. P. and L. O. P.—Posterior positions of the occiput are *primary* or *acquired*. They are primary if the head enters the inlet with the occiput posterior. They are acquired if the head rotates from an anterior position at the beginning of labor to a posterior position at its close. Acquired posterior positions of the occiput are very rare.

Diagnosis.—Palpation reveals the fetal back in the maternal flank (to the right in R. O. P., to the left in L. O. P.). The extremities are found on the opposite side in front, the head below. The heart-sounds are heard in the flank below a transverse line through the umbilicus. Digital examination shows the small fontanel toward the right or left sacro-iliac joint; the sagittal suture in an oblique diameter of the pelvis.

The mechanism is the same as the mechanism of anterior positions, including anterior rotation of the occiput under the arch of the symphysis. As a consequence, however, of the prolonged rotation of the occiput, sweeping over about one-third of a circle, a peculiarity in the mechanism is the rotation of the shoulders at the superior strait through a third of a circle,—a movement not seen in anterior positions. And, further, in consequence of the greater distance which the occiput must traverse,

the clinical manifestations of this position are different, there is greater pain, and labor is more prolonged. After rotation has occurred the shoulders descend and rotate on the pelvic floor, as in anterior positions. The remainder of the mechanism is identical with that of anterior positions.

The cause of the forward rotation of the occiput is the same as it is in anterior positions,—namely, *whatever portion of the fetal body first strikes the resistance of the pelvic floor, whether it encounters this structure behind or in front of the median transverse*

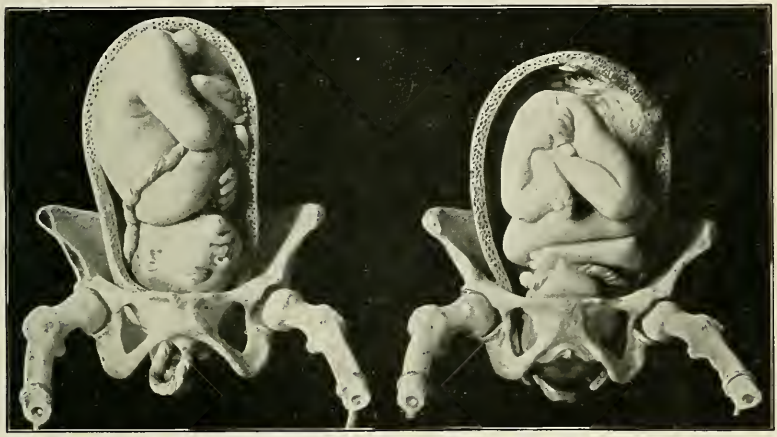


Fig. 270.—Posterior positions of a vertex presentation.

line, is directed forward, inward, and downward, under the arch of the symphysis. As the occiput or the region around the smaller fontanel is the most dependent part of a vertex presentation, it must first encounter the resistance of the pelvic floor, and must, accordingly, be rotated in the directions named.

Abnormalities in Mechanism.—*Backward rotation* of the occiput complicates labor by protracting its course, increasing the danger of fetal death, and subjecting the mother to increased risk of injury.

The causes may be divided under three heads :

Anomalies of Force.—Anterior rotation is the resultant of the forces of expulsion and resistance ; hence, any condition disturbing the normal relation of these forces interferes with the normal rotation. Thus, backward rotation occurs if there is diminished expulsive power, increased resistance or decrease in resistance, as occurs in cases of very large pelves, relaxed pelvic floors, small and yielding heads.

Anomalies of Flexion.—If flexion is imperfect, the anterior vault of the cranium (as in those rare cases of presentation of the large fontanel), the brow, or the chin *first strikes the pelvic*

floor, and is, therefore, directed forward, and the occiput is thus directed backward.

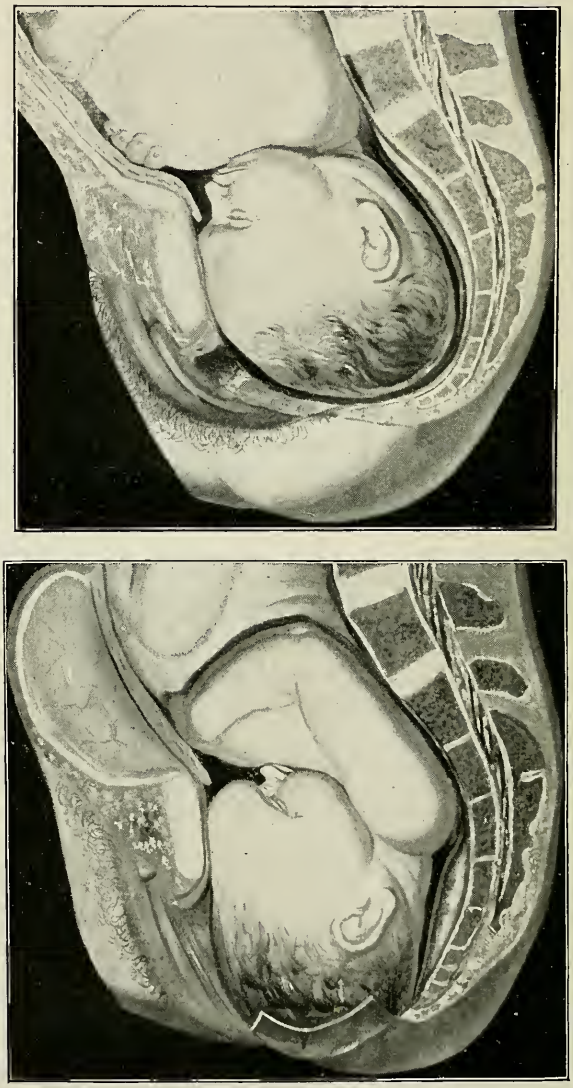


Fig. 271.—Posterior position of a vertex presentation : backward rotation of the occiput.

Insuperable Obstacles to Forward Rotation.—In some cases if flexion is only fairly good, and the *occiput* does first strike the pelvic floor, the occiput rotates backward, because the large diameter of the head (fronto-occipital, 11¾ cm.—4⅝ in.) is engaged,

and rotation from one oblique diameter of the pelvis to the other oblique is impossible, on account of the very tight fit of the head in the pelvis. The occiput is also directed backward for the same reason, if the fetal head is oversized. The wedge of a prolapsed extremity may prevent forward rotation. In some deformities of the pelvis, particularly in kyphotic, generally contracted, and Naegele's pelves, the occiput rotates backward. If there is an abnormal projection of the lumbar and sacral vertebræ, interfering with rotation of the shoulder, the head may not be able to rotate anteriorly. Rarely there may be rotation of the head without a corresponding movement of the body, and the result is an exaggerated torsion of the neck. I have seen a child fatally injured in this manner. In the other cases under my observation and in most of the reported cases, however, the infant has escaped unharmed.

The Mechanism of Labor when the Occiput Rotates into the Hollow of the Sacrum.—The occiput is propelled forward over the perineum by increased flexion until the face is finally born under the symphysis by partial extension. This mechanism subjects the cranium of the fetus to dangerous pressure, and greatly increases the risk of perineal rupture by subjecting the structures of the pelvic floor to an enormous strain.

Abnormalities in the Mechanism Just Described.—There may be abnormal resistance to the descent of the occiput, resulting in a conversion of the presentation into one of the large fontanel, brow, or face, by an extension of the head.

As **causes** of this anomaly, projecting ischiatic spines or a central tear of the perineum have been reported.

Treatment of Posterior Positions of Vertex Presentations.—The medical attendant must bear in mind the causes of backward rotation, and should try to prevent its occurrence. For this purpose it is essential to secure perfect flexion of the head by placing the patient on that side toward which the fetal back is directed, and to obtain a normal action of the expulsive and resisting forces. If the pelvic floor is weakened, and does not supply sufficient resistance, it should be reinforced by two fingers in the vagina or by a single blade of the forceps, imitating the shape and direction of the pelvic floor, and used as a lever to pry the occiput forward. In a favorable case with a capacious pelvis and vagina and a comparatively small head it is possible to insert the whole hand in the vagina and, grasping the head with the outstretched fingers and thumb, to twist the occiput forward. It is occasionally possible to favor rotation of the head by an external manipulation of the shoulders. Pushing that shoulder forward or backward which is most easily accessible, the anterior rotation of the back is secured, followed perhaps by a corresponding

rotation of the head. If the expulsive power is faulty, a single large dose of quinin may be administered, or forceps may be applied. I find that forceps used as a rotator is the easiest and surest means to secure forward rotation of the occiput on the pelvic floor. As traction is made the blades gradually turn till they are three-quarters of the way upside down. They are then removed and reinserted in the appropriate manner for a right occipito-anterior position. This is a better plan than the rotation of the head at or above the pelvic brim. As in the vast majority of cases rotation occurs spontaneously on the pelvic floor, the deep insertion of the hand and the rotation of the head at the brim is usually unnecessary. If backward rotation occurs in spite of the precautions to prevent it, extraordinary care should be exercised to protect the vaginal walls and the perineum from laceration, and to avoid a protracted second stage of labor. These results can usually be accomplished by a judicious use of the forceps. It might be an advantage, in rare cases, to convert the vertex into a face presentation by retarding progress of the occiput and assisting the extension of the head.

Prognosis.—The outlook is not so favorable as it is in

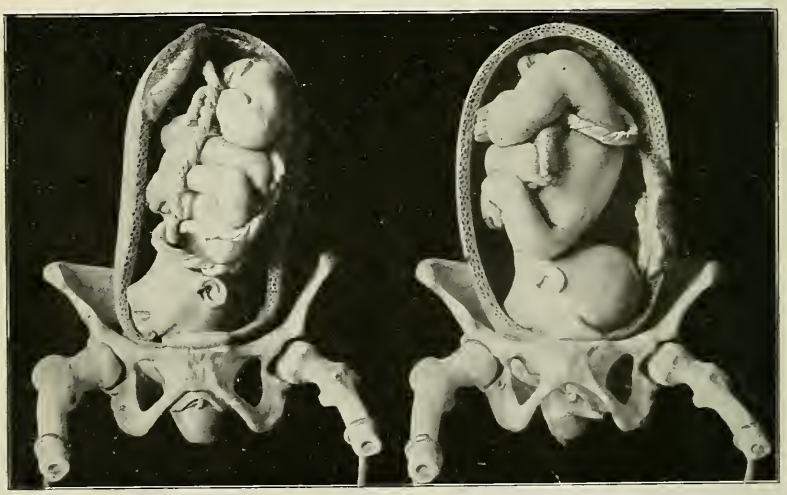


Fig. 272.—Face presentation : right mento-anterior and right mentoposterior positions.

anterior positions of the occiput. The forceps is often required (once in seven cases). Laceration of the maternal soft parts is much more frequent. The mortality of the fetus is increased from less than 5 per cent. (the average mortality of normal vertex) to more than 9 per cent.

Fortunately, backward rotation of the occiput in vertex presentations occurs in only about 1 ½ per cent. of all labor cases.

Face Presentations.—In this presentation the head is extremely extended. The chin is the most dependent and prominent portion of the presenting part; hence the positions are named by its relations to the maternal structures, as left mento-anterior, right mento-anterior, etc. Every face presentation begins as a presentation of the brow, the extreme extension only occurring when the head is subjected to the action of the uterine pains and the resistance of the walls of the genital canal.

Frequency.—Face presentations occur about once in 250 labors, or in less than 0.5 per cent.

Diagnosis.—The unusually prominent bulk of the cranial vault is felt in one hypogastric region; a deep groove between the occiput and the child's back may often be made out. The fetal heart-sounds are loudest over the anterior surface of the fetus, or on that side of the maternal abdomen upon which the fetal extremities are felt. The diagnosis, however, must usually rest on a digital examination, which shows before the onset of labor a high situation of the presenting part; a flattening of the anterior vaginal vault; a sharp contrast between the smooth

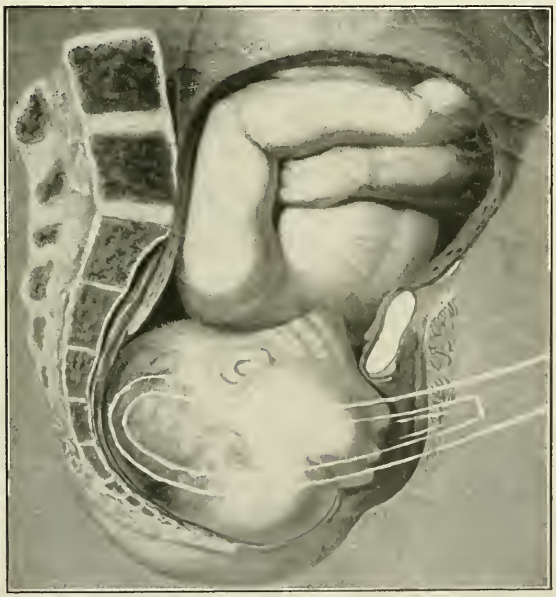


Fig. 273.—Face presentation. Delivery of the face.

outline of the fetal forehead and the irregular contour of the face. As soon as the os is dilated, the characteristic features of the face may be felt. A face presentation has often been mistaken for a presentation of the breech. The orbital ridges, the

eye-sockets, the chin, and, most distinctive of all, the hard gums within the mouth, should enable any one to make the differential diagnosis. This presentation should be considered as a pathological one, for it entails great danger upon both mother and child.

The causes of face presentations are divided under three heads, as follows: (1) Conditions preventing flexion, as tumors of the neck; increased size of the thorax; constriction of the cervix about the neck; coiling of the cord around the neck; tonic contraction of the neck muscles.

(2) Conditions favoring extension, as mobility of the fetus; oblique position of the child and uterus, especially when the abdominal surface of the child is directed downward and the pelvis is flat; a dolichocephalic head, in which the posterior segment of the skull is longer than the anterior; tumors upon the back, as spinal meningocele. Causes which promote extension of the trunk and shoulders, and consequently of the head, as an overfilled bladder of the mother pressing upon the child's back. After the head has descended into the pelvic cavity, the face presentation may be due to the conversion of an occipito-posterior position into that of the face, as already described.

(3) Anything that interferes with the normal engagement of the head in the pelvis, as overgrowth of the fetus, deformed pelvis, pelvic tumor.

The Mechanism.—The successive steps of the mechanism of labor in a face presentation occur in the following order:

Extension. The head presents at the superior strait imperfectly extended, so that every case of face presentation may be said to begin as a brow presentation. There is also at first imperfect engagement of the presenting part, on account of the large diameters presented at the superior strait. Under the influence of the expulsive action of the uterus and the resistance of the pelvic walls, the brow, caught upon the pelvic brim, is held stationary, while the chin descends lower and lower by an extreme extension of the head.

Molding, or an accommodation of the shape of the presenting part to the shape of pelvis, occurs to a moderate degree or not at all, because the face is a loose fit in the normal pelvis. The molding is confined to the back of the skull.

Lateral inclination is a constant feature, so that one cheek is a little deeper in the pelvic canal than the other one.

Descent of the presenting part follows the dilatation of the cervical canal, the descent of the chin being accomplished almost solely by the extension of the head, and not by a descent of the head as a whole.

Anterior rotation of the chin occurs as soon as it encounters

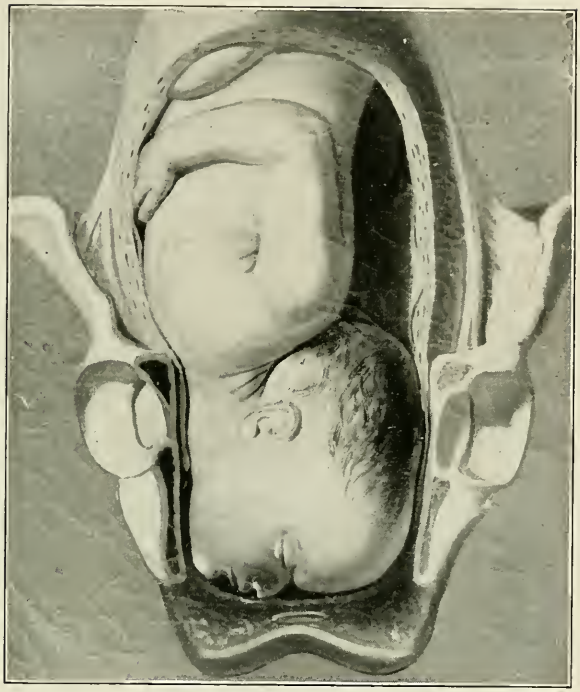


Fig. 274.—Face presentation, chin directed laterally.

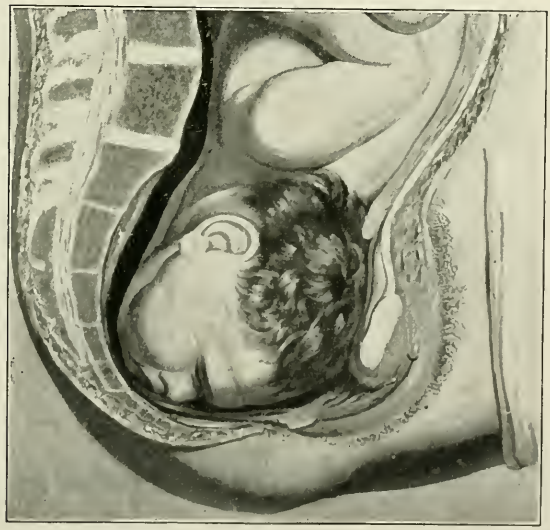


Fig. 275.—Face presentation, chin posterior.

the resistance of the pelvic floor. Anterior rotation is followed by the engagement of the chin under the symphysis pubis.

Then follows the delivery of the head by flexion and propulsion, the mouth, nose, eyes, and forehead sweeping over the perineum and appearing successively at the posterior commissure.

Restitution and external rotation follow the escape of the head from the same causes that impose these movements upon the head in a vertex presentation. The delivery of the body takes place as in a vertex presentation.

Abnormalities in Mechanism.—The most common and most important anomaly of mechanism is a delay in the forward rotation of the chin under the symphysis. This delay is due to the difference between the lateral depth of the pelvis (8.8 cm., or 3½ in.) and the length of the fetal neck (3.8 cm., or 1½ in.), as a consequence of which the chin may not encounter the necessary resistance to turn it forward, and without this forward movement it is impossible for the head to escape through the vulvar orifice. Should the chin be directed posteriorly, where

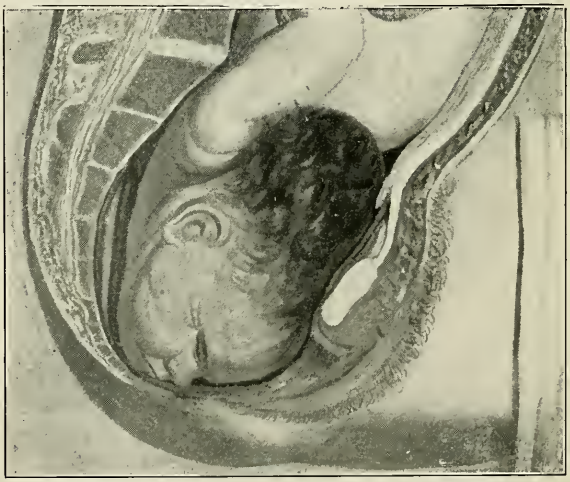


Fig. 276.—Face presentation, chin posterior; enormous elongation of neck.

the depth of the pelvis is even greater (5 inches), the delay is absolute, and such cases can only be terminated by artificial assistance. If the condition is left to nature, there is an effort to force the upper portion of the thorax (9 cm.) into the pelvic cavity, along with the posterior half of the child's skull (9½ cm.), for only thus can the chin descend sufficiently to be turned anteriorly under the pubic arch, but it is obviously impossible for the bulk of these two diameters to pass through the pelvis. If the chin is posterior, it may rotate to a transverse position, and

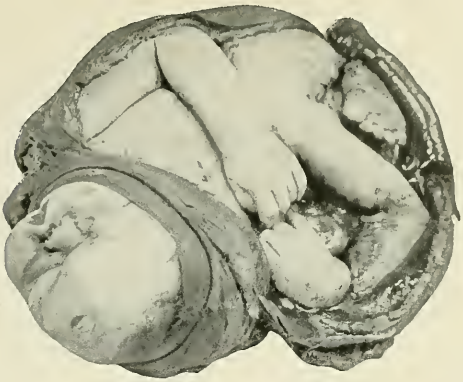


Fig. 277.—Face presentation.

Fig. 278.—Face presentation.

Fig. 279.—Face presentation. Specimen presented to the author by the late Dr. Formad, coroner's physician. The woman had died during futile attempts to extract the head with forceps. The chin was posterior, but had rotated to a lateral position, without corresponding movement of the shoulders. This brought the occiput in relation with the right shoulder, so preventing any further extension of the head and adding thereby to the difficulties of the case.

then all progress may cease, because the occiput catches on a shoulder and so further extension of the head is prevented (Figs. 277, 278, 279). A most serious complication of face presentation for the child is the displacement of the arms posteriorly on the child's back or neck.[1]

Prognosis.—The fetal mortality of face presentations is 13 to 15 per cent. The maternal mortality rises from less than 1 per

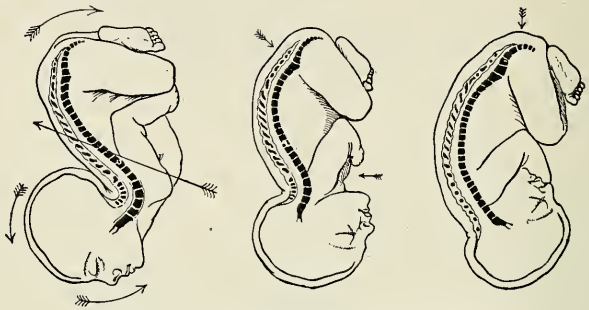


Fig. 280.—Schatz's method of cephalic version.

cent. in all labors to 6 per cent. or over, if one takes into account cases of anterior and posterior positions and those which are mismanaged or neglected in general practice.

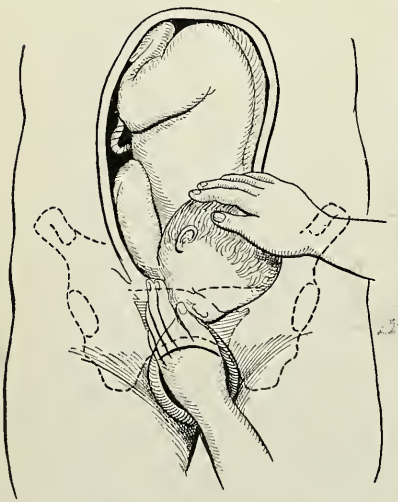


Fig. 281.—The conversion of a face into a vertex presentation (Baudelocque).

Treatment.—If the chin is directed well forward of the transverse diameter of the pelvis, the labor may require no interference. In posterior positions of the chin, however, the case is always difficult, and demands active treatment. Before labor begins, or in its early stages, the face presentation may be converted into one of the vertex by the method of Schatz—external manipulation (see Fig. 280). By combined pressure upon the breech by an assistant, and upon the anterior wall of the thorax and the occiput, the fetal body is flexed and flexion of the the head is secured. If this plan fail, the methods of Baudelocque

[1] Lindenthal, "Centralbl. f. Gyn.," No. 25, 1899.

(internal and external manipulation) should be tried (see Figs. 281, 282, 283). The chin is pushed up by the internal hand while the occiput is pressed down by external pressure, or the occiput is pulled down by the internal hand, while external

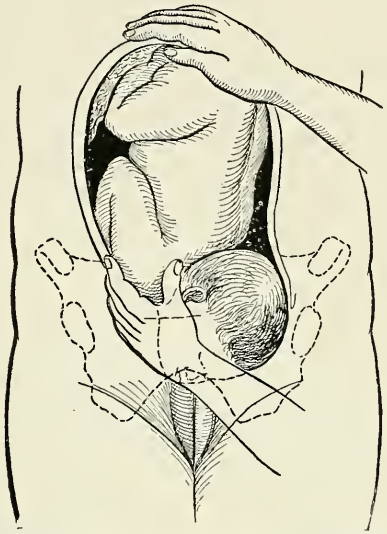


Fig. 282.—The conversion of a face into a vertex presentation (Baudelocque).

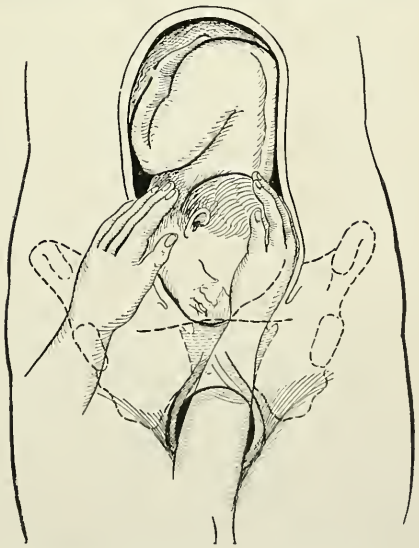


Fig. 283.—The conversion of a face into a vertex presentation (Baudelocque).

pressure flexes the child's body. This attempt also fail-

ing, version should be tried if the face is not impacted in the pelvis. While labor is in progress, care should be exercised not to rupture the membranes, that the os may be more thoroughly dilated and the liquor amnii shall not be drained away. If the presenting part is impacted in the pelvis, and if anterior rotation of the chin is delayed, it may be hastened by two fingers pressing on the posterior cheek and chin, supplying the kind and shape of resistance that should be afforded by the pelvic floor, which the chin can not reach; or, if more convenient, pressure may be applied with a single blade of the forceps. If anterior rotation can not be effected in this manner, a straight forceps may be used to compel rotation by twisting the head, and, if the chin is directed anteriorly, traction may be made upon the forceps. If the chin is directed backward, traction should *never* be attempted. Finally, after failure of efforts to convert the face presentation into a presentation of the vertex, to perform version and to rotate the chin craniotomy is necessary.

At the last part of the second stage of labor care must be exercised in the final delivery of the head, not to push the neck too forcibly against the symphysis while trying to prevent laceration of the perineum.

Presentation of the Brow.—In this presentation the head remains throughout labor midway between complete extension and complete flexion. Therefore, the largest diameters of the head present at the superior strait. Of all presentations of the head this is the most unfavorable for both mother and child. The four positions of the presentation are named according to the direction of the chin.

Frequency.—In Guy's Hospital there were 14 brow presentations among 24,582 births (1 in 1756). In Bern it occurred 44 times in 19,725 labors[1] (1 in 448).

The **diagnosis** is made by digital examination. It would be practically impossible to distinguish by abdominal palpation the difference between a face and a brow presentation.

Mechanism.—The steps of the mechanism are the same as those of a face presentation. If the chin is directed posteriorly, progress is impossible, for the same reasons that make a posterior position of a face presentation an insuperable obstacle in labor.

Prognosis.—The fetal mortality has been computed to be thirty per cent.; the maternal, ten per cent. The latter, however, depends entirely upon the woman's treatment. Competent management should insure the mother's safety.

Treatment.—Before labor, or in its early stages, the brow should be converted into a vertex presentation. This can sometimes be accomplished by external pressure on the occiput to

[1] Moosmann, "Inaug. Diss., Bern," 1903.

secure flexion, as in Schatz's method of treating a face presentation. If this plan fail, the hand may be inserted into the vagina and uterus to pull the occiput down. Should this attempt not succeed, it would be best to convert the brow into a face presentation if the chin is anterior. Failing in this, version should be tried if the waters are not drained off or if the presenting part is not fixed in the superior strait. If the chin is anterior and the presenting part is firmly fixed in the pelvis, the application of the forceps usually succeeds; if the chin is posterior, and if conversion into a vertex presentation, performance of version and rotation are all impossible, craniotomy is indicated. In face and brow presentations with the chin posterior, it is a cardinal rule *not* to use forceps except as rotators; if traction is resorted to at all, even in mento-anterior positions, it should be employed with the greatest caution and gentleness. *Very rarely*

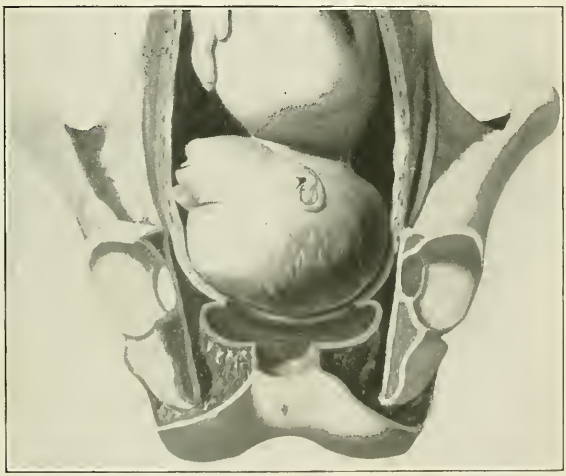


Fig. 284.—Presentation of the greater fontanel.

the head may be brought down far enough to meet with resistance, and thus be rotated anteriorly; but unless the head yields to moderate traction, embryotomy is preferable.

Presentation of the Greater Fontanel.—The head in this very rare presentation is set squarely upon the shoulders in a sort of military attitude of attention, turned upside down. In its clinical features this presentation resembles that of a brow. The descent of the head is difficult and tedious; the anterior (frontal) portion rotates forward, but with great difficulty, and serious injury to the maternal soft parts is almost unavoidable. The stretching of the vaginal walls is so great that

the perineum may be lacerated into the rectum before the head has fairly impinged upon the pelvic floor.

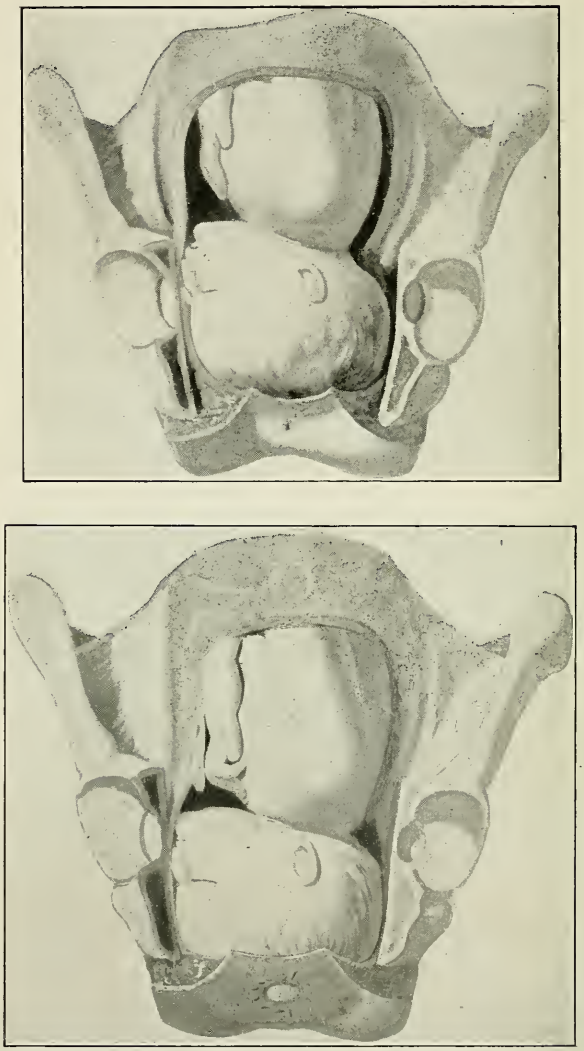


Fig. 285.—Presentation of the greater fontanel; descent of the head, without flexion, to the pelvic floor.

Treatment.—The abnormal position of the head should be altered into a vertex presentation by pulling down the occiput with the fingers or by pushing up the brow while pressure is made upon the occiput from above through the abdominal walls.

Presentation of the Breech.—By a presentation of the breech is meant a presentation of any part of the pelvic extremity of the fetal ellipse. The term, therefore, includes a presentation of the nates, the knees, or the feet. The classification of the positions is made by the direction of the sacrum, as a left sacro-anterior, right sacro-anterior, etc.

Frequency.—Breech presentations occur in 1.3 per cent. to 3 per cent. of all cases, the first figures referring to mature births alone.

Causes.—Abnormalities in the shape of the fetus or in that of the uterine cavity are the chief causes of a breech presentation. Included under this head are reversal of the uterine ovoid (the lower uterine segment larger than the upper), fetal monstrosities, twin pregnancy. Increased mobility of the fetus accounts for a small proportion of the cases, especially in premature births.

Diagnosis.—By abdominal palpation the head is found above, the breech below. The heart-sounds are heard above the level of the umbilicus. Digital examination shows a high position of the presenting part; an absence of the dome-like projection of the vaginal vault which is found in a presentation of the head; the bag of waters projects through the os as a pouch-like protrusion; by pressure on the fundus with the external hand the characteristic features of the breech may be detected by the finger in the vagina—namely, the nates and the sulcus between them, the tip of the sacral bone and the coccyx, the thighs, the external genitalia, and the anus. Evacuation of meconium is the rule in a breech presentation; so that the examining finger is found stained with it, after the membranes have ruptured.

The Mechanism of Labor.—The following steps are to be noted: Dilatation of the cervix and descent of the breech to the pelvic floor. This occurs very slowly, because the soft breech is an imperfect dilator of the cervix and an ineffectual irritator of reflex uterine contractions; hence many hours may be required for the first stage of labor. Rotation forward of the anterior hip, which is the first to encounter the resistance of the pelvic floor. Owing, however, to the insufficient resistance which the soft breech encounters, its rotation is imperfect.

There then follows the birth of the anterior hip, posterior hip, the thighs, and the trunk. The next and a very important step is the engagement and descent of the shoulders in an oblique diameter of the pelvis. The anterior shoulder, first encountering the resistance of the pelvic floor, is turned forward under the pubic arch. Then occurs the birth of the anterior followed by that of the posterior shoulder. The head by this time has

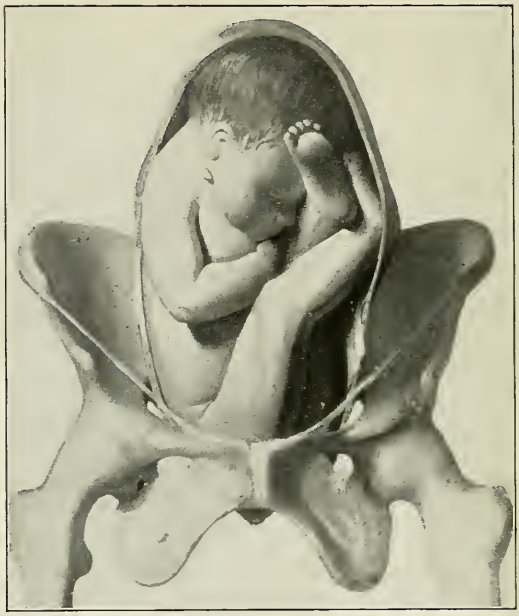


Fig. 286.—Breech presentation, right sacroposterior position.

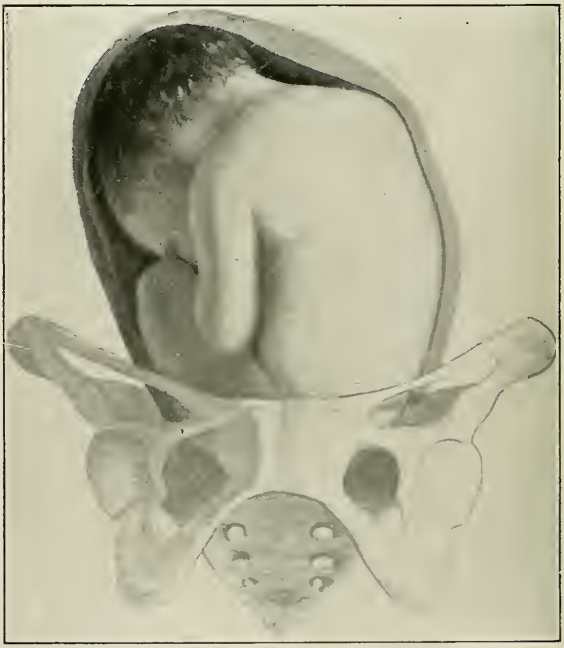


Fig. 287.—Breech presentation, left sacro-anterior position.

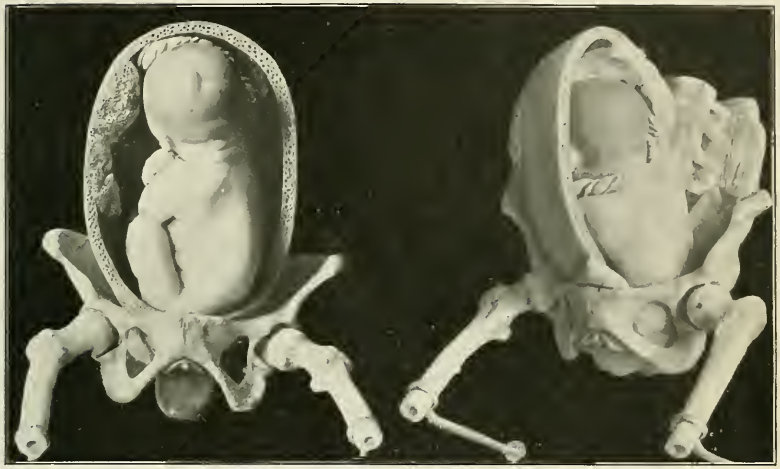


Fig. 288.—Breech presentations, left sacro-anterior position.

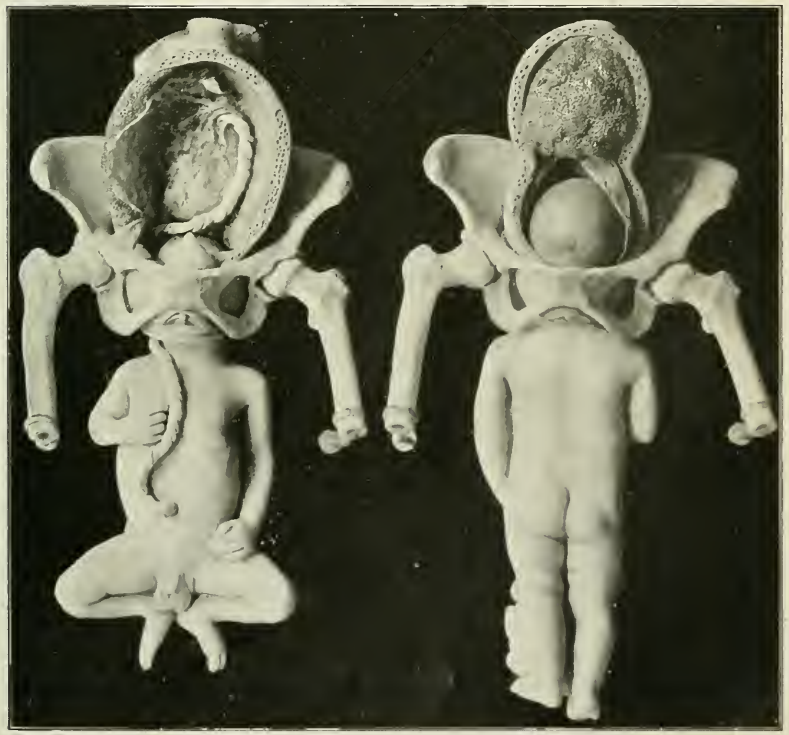


Fig. 289.—Breech presentations, anterior and posterior positions.

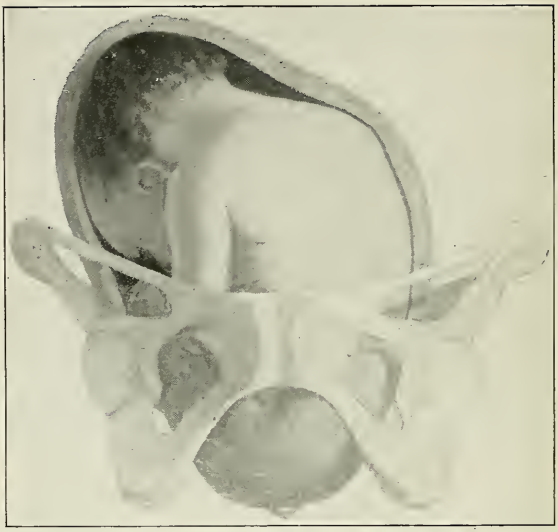


Fig. 290.—Same as figure 287, showing descent of breech through the pelvic canal.

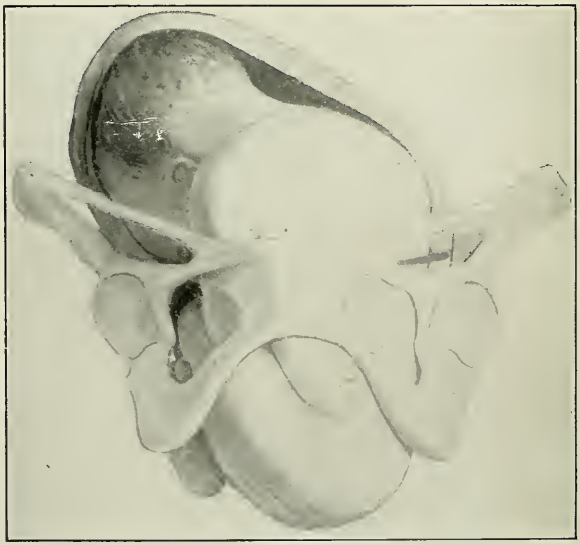


Fig. 291.—Same as figure 290, showing engagement of the shoulders in the pelvis.

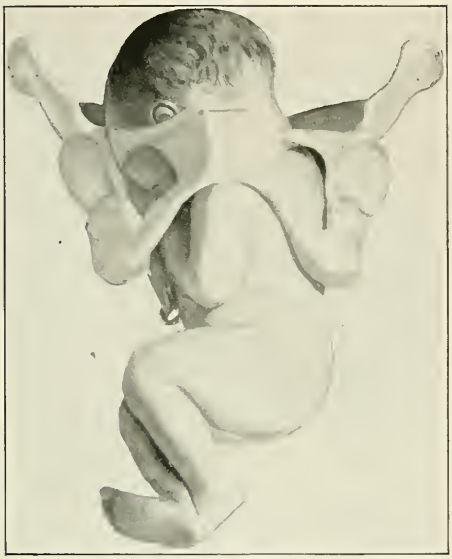


Fig. 292.—Same as figure 291, showing escape of extremities.

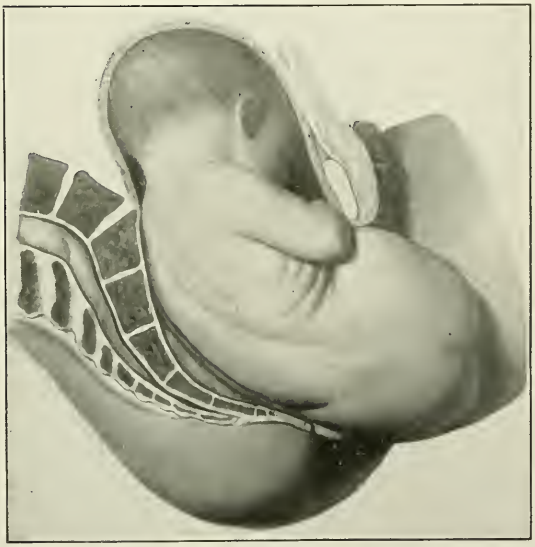


Fig. 293.—Breech presentation—rotation of the hips.

entered the pelvis with its long diameters in the oblique diameter of the pelvis, opposite to that in which the shoulders engaged. The head descends the birth-canal to the pelvic floor in a position of extension. The occiput, which is always the part first to strike the pelvic floor, is rotated forward under the

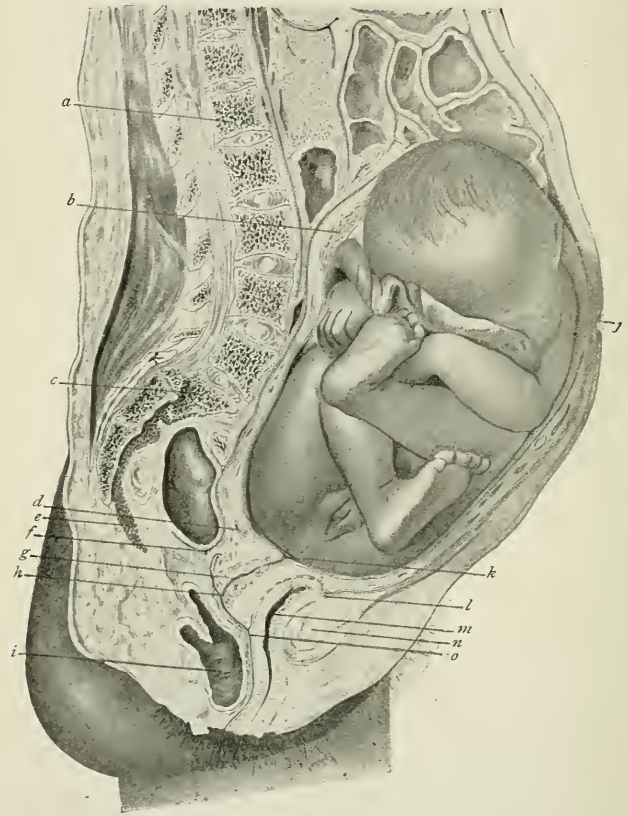


Fig. 294.—Breech presentation. Waldeyer's section of an X-para at full term, who died from hemorrhage some hours after both her legs had been cut off by a locomotive: *a*, First lumbar vertebra; *b*, placenta; *c*, fractured first sacral vertebra; *d*, coronary vein; *e*, blood extravasation; *f*, pouch of Douglas; *g*, cervical canal; *h*, os externum; *i*, rectum; *j*, umbilicus; *k*, os internum; *l*, uterovesical reflection of peritoneum; *m*, bladder; *n*, symphysis pubis; *o*, vagina.

pubic arch. There follows then the delivery of the head in the following order: Chin, face, forehead, anterior fontanel, sweeping successively over the perineum and appearing in the vulvar orifice.

Prognosis.—The fetal mortality of breech presentations is about thirty per cent., including badly managed cases in gen-

eral practice. There is some added danger of injury to maternal soft parts, on account of the necessity for rapid and sometimes violent extraction of the after-coming head.

Treatment.—Before labor external version may be attempted. It will not always be found practicable, and after the fetal body has been turned there is a disposition on the part of the fetus to resume its original position. The application of two long cylindrical compresses to the sides of the uterus, and a firm abdominal binder, may prevent a return of the breech presentation. When labor has begun, inaction should be the physician's policy until the fetal body is born to the umbilicus, unless maternal or

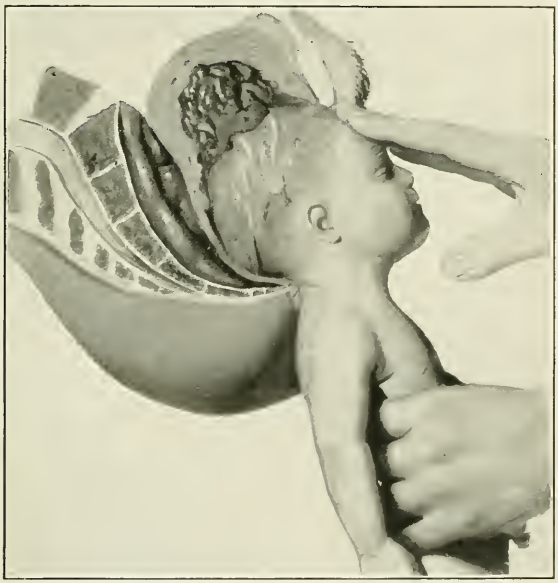


Fig. 295.—Delivery of the after-coming head when it is flexed.

fetal life is threatened or an indication for rapid delivery arises. As soon as the trunk appears the patient should be placed in the lithotomy position across the bed, and delivery of the shoulders and head should be effected by pressing upon the fundus with one hand, the other hand being inserted in the vagina to favor anterior rotation of the shoulder, anterior rotation of the occiput, and to direct the passage of the head through the vagina (Wiegand's method; see Delivery of the After-coming Head).

Abnormalities in Mechanism.—The most frequent and important anomalies are backward rotation of the occiput and excess-

ive rotation of the breech. Backward rotation of the occiput is very exceptional. The mechanism of the delivery of the head in these cases differs as the head remains flexed or becomes extended. When flexed, the chin, face, forehead, and anterior fontanel slip out under the symphysis in the order named, and the head is delivered. When extended, the chin catches upon the symphysis, the head is extremely extended and is born by the occipital protuberance, small fontanel, cranial vault, and face slipping over the perineum. The following rules for managing the extraction of the head in these cases should be remembered: If the head is flexed, the body of the child should be carried downward; if it is extended, the body should be carried upward over the mother's abdomen. Excessive rotation of the breech occurs as the result of a prolapse of a posterior extremity, and is of no great practical importance.

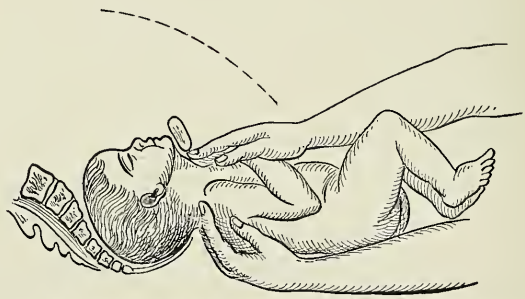


Fig. 296.—Chin arrested at symphysis; head extended (Chailly-Honoré).

The Mechanism of Shoulder Presentations.—A transverse position of the child *in utero* almost always resolves itself into a shoulder presentation as the result of uterine contraction when labor begins. Presentations of the umbilicus (Fig. 305) and of the back (Figs. 302, 303, 304) are possibilities, but are extremely rare. Shoulder presentations are classified according to the positions of the back and head. When the head is to the right, the back may be in front or behind. The same is true when the head is to the left. The back is directed anteriorly twice as often as posteriorly, and the head more than twice as often is found toward the left-hand side of the maternal pelvis.

Diagnosis.—Abdominal palpation reveals the fetus in a transverse position. The heart-sounds are more distinct at a point corresponding to the interscapular region of the child, but sometimes can not be heard. A digital examination shows the characteristic anatomical peculiarities of the shoulder and adja-

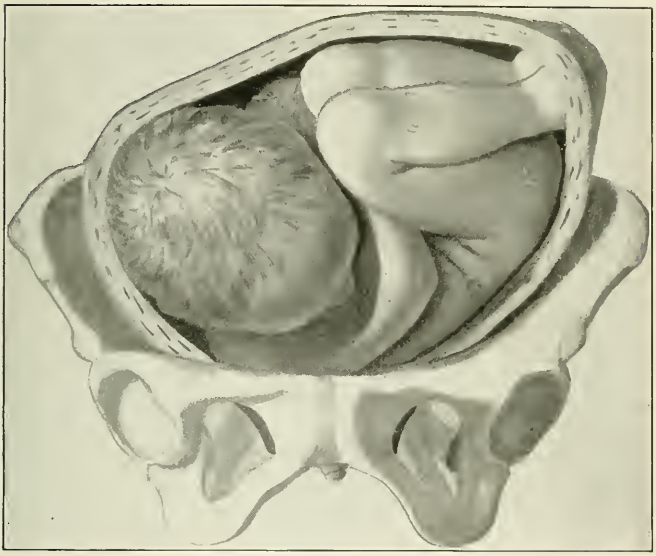


Fig. 297.—Shoulder presentation.

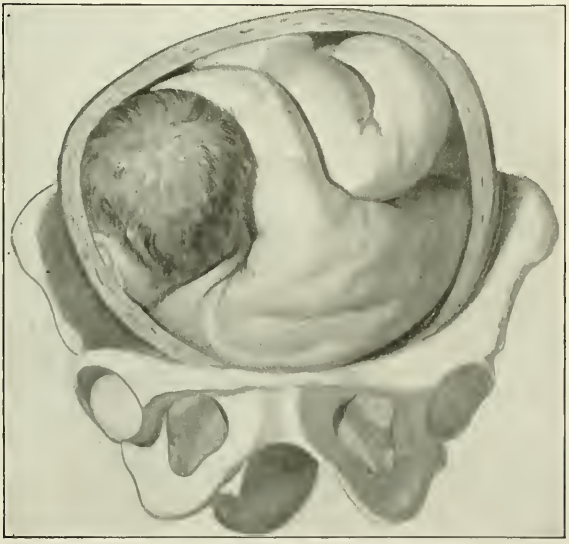


Fig. 298.—Shoulder presentation.

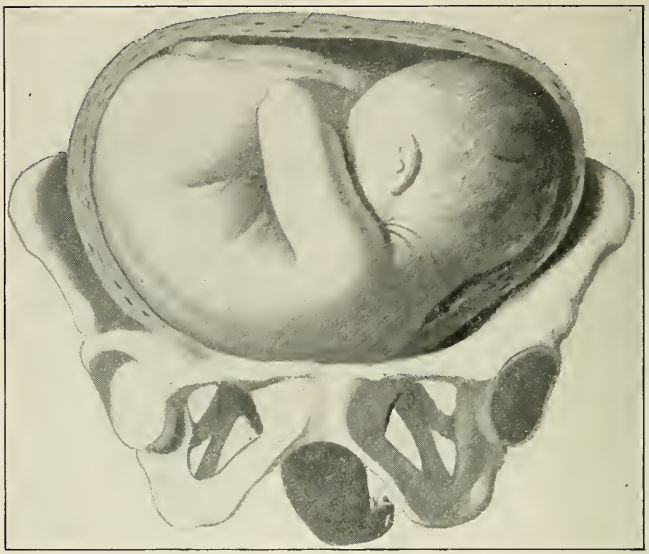


Fig. 299.—Shoulder presentation.

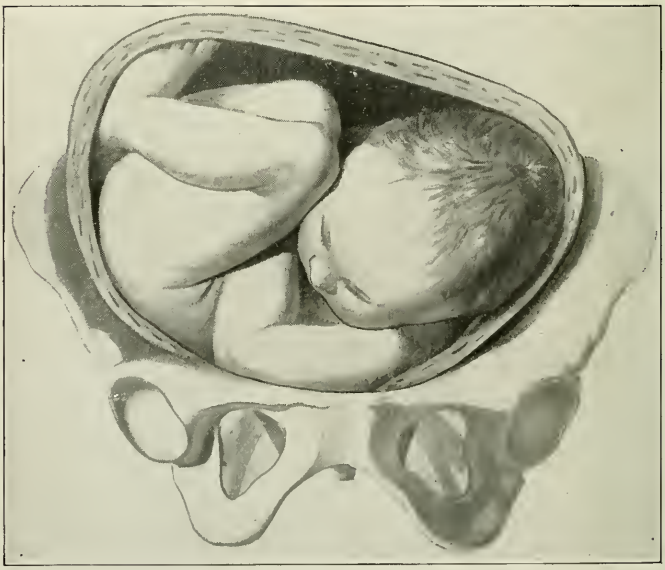


Fig. 300.—Shoulder presentation.

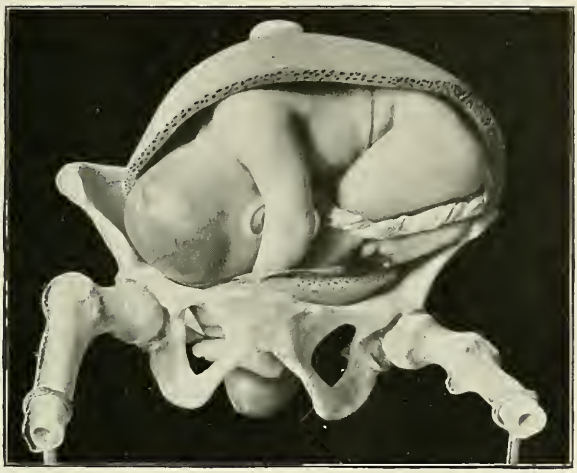


Fig. 301.—Transverse position of the fetus; extremities presenting.

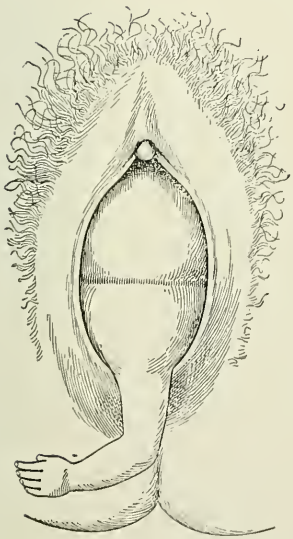


Fig. 302.—Back presentation; the left arm is projecting. The transverse furrow gives the appearance of a breech presentation (Budin).

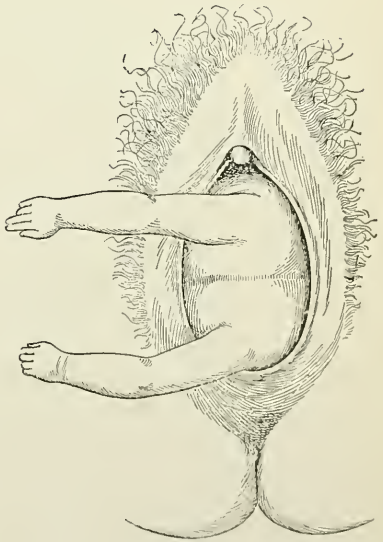


Fig. 303.—Back presentation, the two arms projecting from the external genital organs (Budin).

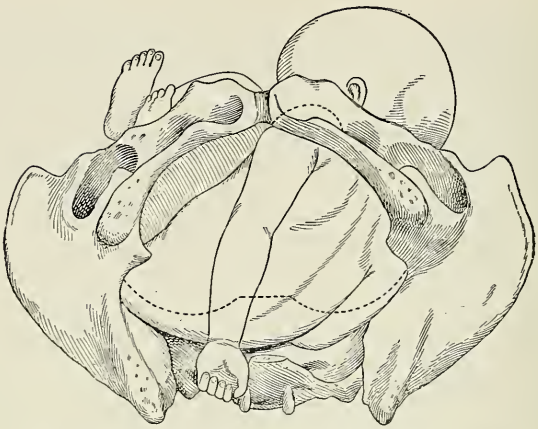


Fig. 304.—Trunk presentation, dorsal variety (Budin).

Fig. 305.—Presentation of the umbilicus.

cent parts—namely, the axilla, the clavicle, the spine of the scapula, the acromion process, the head of the humerus, and the ribs.

Causes.—The causes of a shoulder presentation may be divided under three heads: (1) Abnormalities in the shape and position of the uterus, as a pendulous abdomen; a uterus bicornis; the broad uterus accompanying a kyphotic spine; the distorted uterus due to uterine fibroids and other abdominal tumors, and to multiple pregnancy. (2) Conditions preventing

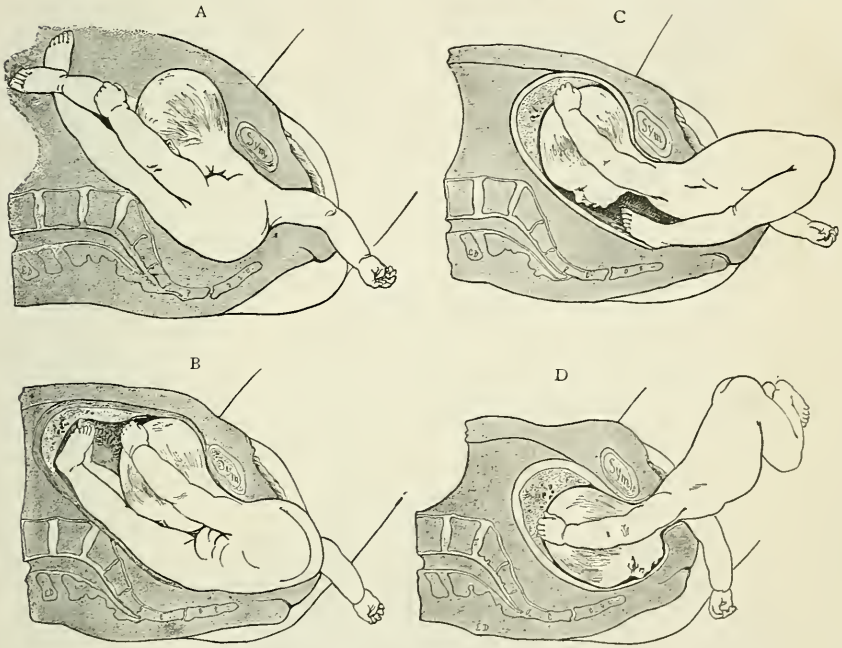


Fig. 306.—Spontaneous evolution.

engagement of the cephalic or the pelvic extremity of the fetus, as deformities of the pelvis; abnormally large child; monstrosities; placenta prævia. (3) Abnormal mobility of the fetus, as in hydramnios, after fetal death, or in premature births.

Mechanism.—Strictly speaking, there is no mechanism of shoulder presentations. The course of these cases is impaction of the shoulder, enormous dilatation of the lower uterine segment, ascension of the contraction-ring, destruction of the fetus by prolonged pressure, and death of the mother by rupture of the uterus or by exhaustion. As a matter of fact, however, nature

can, in very exceptional cases, effect delivery by one of three methods :

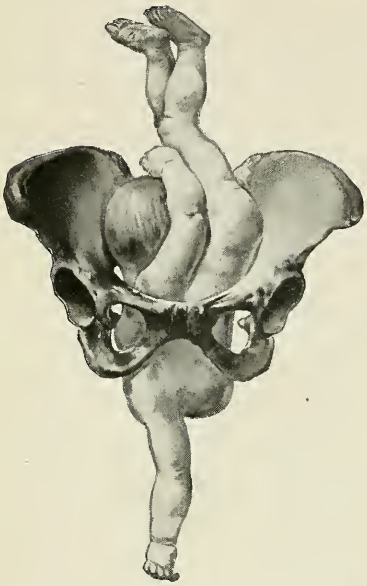


Fig. 307.—Rare form of mechanism, known as birth with doubled body (one-sixth natural size, redrawn from Küstner).

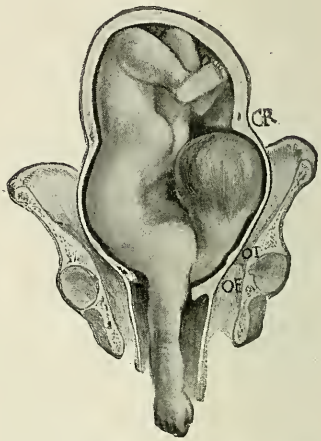


Fig. 308.—Impending rupture of uterus in a shoulder presentation : *oe*, External os ; *oi*, internal os ; *cr*, contraction-ring (Schroeder).

Fig. 309.—Frozen section of shoulder presentation. If the mother had survived, spontaneous evolution might have occurred (Chiara).

Spontaneous version. The transverse position is converted into a longitudinal position by the uterine contractions.

Spontaneous evolution. The breech slips past the shoulder

and is delivered first, the rest of the body following as in a breech presentation.

The body doubled up (corpore reduplicato) is expelled in one mass. This termination is possible only in premature births with a small child, usually macerated.

Treatment.—The treatment of shoulder presentations may be summed up in a single word—version. If the child is dead; if the shoulder is tightly impacted and the lower uterine segment is so distended that the slight additional strain upon its walls of turning the child will probably determine a rupture of the uterus, the child should be decapitated.

MECHANISM OF THE THIRD STAGE OF LABOR.

The mechanism of the third stage of labor is divided into two acts—the separation and the expulsion of the placenta. The most probable explanation of placental separation is found in the

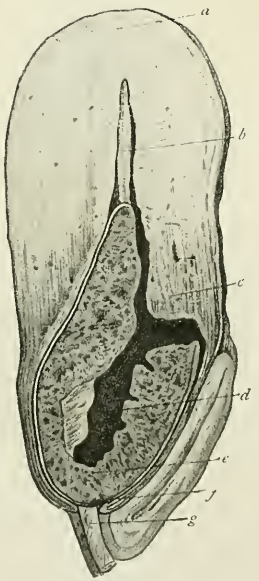


Fig. 310.—Pinard and Varnier's section of the uterus of a V-para who died from collapse (rupture of uterus with hemorrhage) shortly after the expulsion of the fetus: *a*, Fundus uteri; *b*, membranes still attached; *c*, retraction-ring; *d*, retroplacental blood-clot; *e*, inverted placenta; *f*, contracted os externum; *g*, cord presenting.

theory of a diminution in the area of the placental site, which the placenta follows to a certain point, when, becoming solid by the approximation of the villi and the obliteration of the lacunæ, it

can no longer follow the contraction and retraction of the uterus, and is sprung off from the uterine wall. It requires usually several pains to accomplish this result; so that the placenta is not, as a rule, completely detached until about fifteen minutes after the delivery of the child, when it may be found lying in the dilated pouch of the lower uterine segment and cervical canal. The walls of this portion of the birth-canal are so flaccid from pressure paralysis and overdistention that the placenta

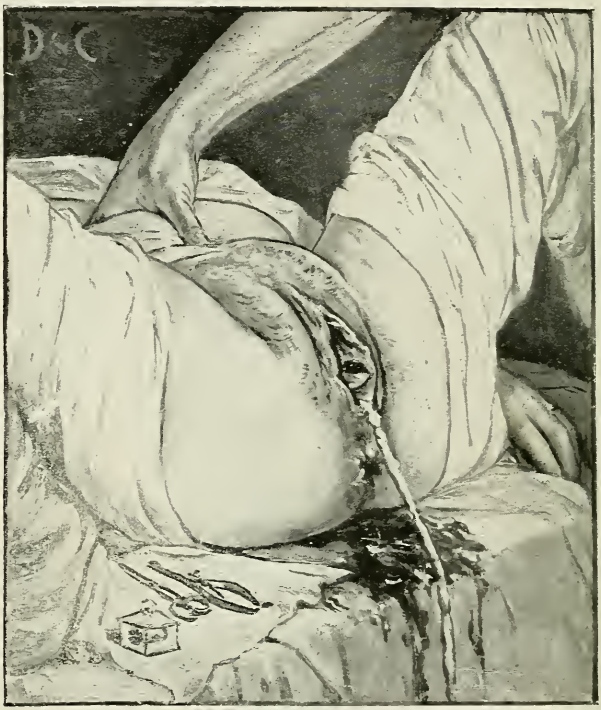


Fig. 311.—Credé's method of expressing the placenta (photographed from nature) (Dickinson).

might remain there many hours, perhaps days, unexpelled. Hence it is that artificial assistance is almost always required to express the placenta. The placenta is usually expelled like an inverted umbrella, the fetal surface coming first with the membranes trailing after it. It occasionally, however, escapes edgewise.

Abnormalities in the Mechanism of the Third Stage of Labor.—Retention of the placenta occurs very frequently. As the placenta is fully separated, the hemorrhage is slight. The

placenta simply lies in the dilated lower uterine segment and the upper portion of the vagina.

The **treatment** is the proper application of Credé's method of expression. Sometimes the placenta lies across the os

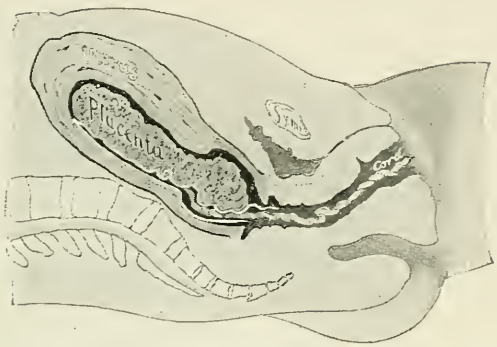


Fig. 312.—The expulsion of the placenta edgewise (Varnier).

uteri so that atmospheric pressure determines its retention. In such cases a finger may be hooked over one edge to pull it down.

Adhesion of the placenta to the uterine wall occurs about once

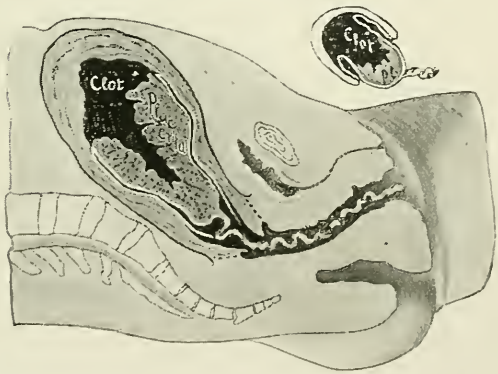


Fig. 313.—The expulsion of the placenta inverted (Varnier).

in 312 cases. The adhesion is rarely complete; a part of the placenta is usually detached. Hemorrhage is a necessary consequence. The placental sinuses are torn when the placenta is

detached, but the womb can not contract and close them, because of the attached area and in consequence of the retention of the whole placental mass within the uterus (see Fig. 314).

Causes.—Adhesion of the placenta usually occurs in a woman who has had endometritis; often as a consequence of syphilis. There is usually an excess of connective tissue in the

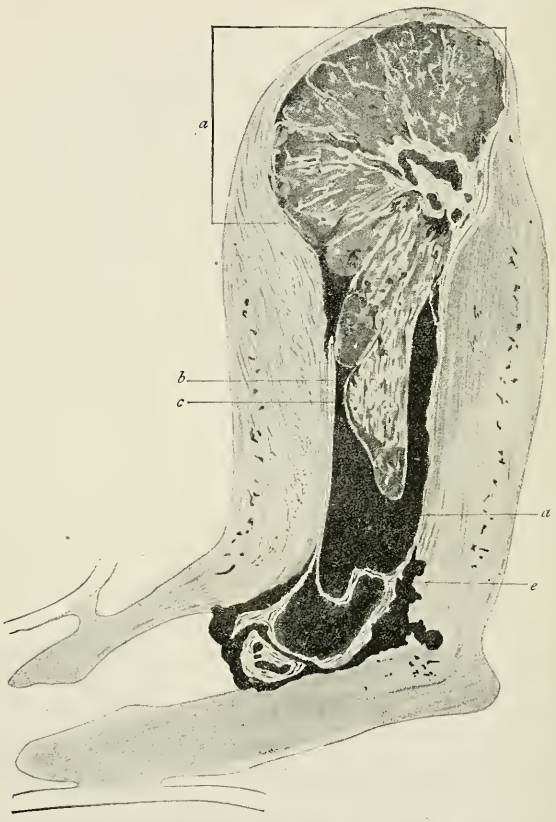


Fig. 314.—Partial detachment of the placenta. Vertical mesial section from a case of eclampsia, delivered *in articulo mortis* by forceps: *a*, Placenta still attached; *b*, placenta separated from its site and hanging free; *c*, membranes; *d*, blood; *e*, membranes (Stratz).

decidua, glandular atrophy, and penetration of the myometrium by the chorion villi, which have burrowed into it.

Diagnosis.—Credé's method of expression fails completely to express the placenta; the womb will not firmly contract, and there is alarming hemorrhage.

Treatment.—The hand should be inserted along the cord as

a guide to the placenta. A detached edge should be sought, under which the fingers are inserted, and the separation is completed with the finger-tips, moving them from side to side. Occasionally it is necessary to pinch through a dense spot of adhesion with the thumb and forefinger. The placenta being separated, the fingers should be closed about it. The fundus should be stimulated by friction through the abdominal wall, and the uterine contractions should be allowed to expel the hand

Fig. 315.—Method of manipulation for artificial separation of the adherent placenta (Dickinson).

and the contained placenta. It is unwise to pull the placenta out, even when it is completely detached, for the combined mass of the placenta and hand may act like the piston of a syringe and draw the uterus inside out.

Ahlfeld has reported a case in which he found it impossible to detach an adherent placenta. He packed the uterus with gauze; on removing the packing twenty-four hours later the

placenta, which had meanwhile become detached, was extracted clinging to the last strip of gauze.[1]

Prognosis.—Many women die from hemorrhage; about seven per cent. from sepsis. Most exceptionally the placenta is retained *in utero* for months without doing harm.[2] The rarest anomalies in the mechanism of the third stage of labor are hernia of the placenta through the muscular coat of the uterus and prolapse of the normally situated placenta. The latter is most likely to happen with twins, after rupture of the uterus, or in premature labor, but it has been observed at term, without injury to the uterus, and in a single pregnancy. There is not necessarily profuse hemorrhage nor other disadvantage to the woman, but the fetus dies unless it is extracted at once.[3]

[1] "Zeitschr. f. prakt. Aerzte," Bd. viii, H. 13.

[2] Wallace, "Indian Medical Record," abstract in London "Lancet," 1891, reports the retention *in utero* of an almost full term placenta for two months without inconvenience to the mother. Loisniel ("Nouv. Arch. d'Obstet.," May, 1892, supplem.) reported a case in which the fetal head, after decapitation, was left in the uterus for three months without symptoms of sepsis. Herrgott, in the discussion of this report, stated that he had seen the placenta retained within the uterus for seven months after childbirth.

[3] "Prolapsus Placentæ," Ingerslev, "Centralbl. f. Gyn.," No. 40, p. 941, 1893; "Zur Kasuistik des Prolapsus Placentæ bei normalem Sitz derselben," *ibid.*, No. 5, 1893. "Hernia of the placenta through the muscular coat of the uterus during labor," J. G. Lynds, "Med. News," 1893, p. 77.

PART IV.

THE PATHOLOGY OF LABOR.

CHAPTER I.

ANOMALIES IN THE FORCES OF LABOR.

In a normal labor the active forces of expulsion (the uterine and abdominal muscles) and the passive forces of resistance (the fetus, the pelvis, and the maternal soft structures) are so nicely balanced that the expulsive forces are just sufficiently resisted to insure a slow and gradual passage of the fetus along the birth-canal. The walls of the birth-canal and the structures around the vulvar orifice are by this arrangement slowly and gradually dilated, and are not violently torn apart, as they would be by a more rapid expulsion of the fetus. This balance between the powers of labor is easily disturbed. There may be anomalies by deficiency and anomalies by excess in the component parts of the forces of expulsion and in all the sources of resistance. Thus, the uterine muscle may be too weak or too strong compared with the resistance it must overcome; and so also with the action of the abdominal muscles. The resistance furnished by the pelvis, the soft structures, and the fetus may be excessive or deficient.

Deficient Power of the Uterine Muscle; Inertia Uteri.—In this condition the uterine muscle is unable to overcome the normal resistance offered by the weight of the fetal body, by the friction of the pelvic walls, and by that of the undilated maternal soft structures. Inertia uteri is manifested, in the vast majority of cases, during the first stage of labor. The weakened uterine force, therefore, is almost always neutralized by the obstruction of an undilated cervix. There is scarcely another condition in obstetric practice that can be traced to such a variety of causes or that demands so many different plans of treatment.

Etiology.—Deficient power of the uterine muscle in labor

may be due to a defect of the muscle itself, to some anomaly of innervation, or to a mechanical interference with the full and effective action of the muscle. Examples of the first-named cause may be found in imperfect development of the uterus or in anomalies of development, as in uterus bicornis. The uterine muscle may be exhausted by rapidly succeeding pregnancies. It may be overdistended by twins or by hydramnios, thus losing the power gained by cohesion of muscular bundles. The uterus may be weakened by some cause—as an adynamic fever or a wasting disease—that weakens the whole organism, but it does not necessarily follow that uterine weakness always accompanies a reduction of body-strength. Women in the last stages of phthisis or in the midst of an attack of typhoid fever or pneumonia occasionally exhibit a uterine power in labor above the normal. The uterus may be weakened by profuse hemorrhage, as in placenta prævia. It may be rendered incapable of exerting normal force in dry labors. The liquor amnii having drained off completely early in the first stage, the uterus retracts upon the child's body, thus being subjected in certain regions to severe and long-continued pressure, and becoming in those spots anemic and friable, while in the areas free from the pressure of the child's body the uterine wall becomes congested, swollen, and edematous. Above all, the uterine muscle may be fatigued. This is the commonest cause of uterine inertia. It is seen oftenest in primiparæ, in whom inertia is more than twice as common as in multiparæ, on account of the difficulty of dilating the rigid cervical tissues. Inertia may appear in consequence of any serious obstruction in labor. At first the pains are feeble, infrequent, and inefficient, but as labor continues the uterine contractions gather force. The inertia from this cause is likely to be only temporary, seen at intervals between periods of stormy uterine action or of long-continued tonic spasms, until finally exhaustion of the whole organism threatens the patient's life or the uterus ruptures.

It has been asserted that an anomaly of innervation in the anatomical sense, a deficient supply of the terminal nerves in the individual muscle-cells, is a cause of uterine inertia, but it is not yet clearly demonstrated to be so. An inhibitory nervous impulse to the uterine muscle, on the contrary, is a frequent cause of uterine inaction. It is the result of some emotion or of great pain. That the "doctor has frightened the pains away" on his first arrival has become proverbial in the lying-in room. The presence of any one who is a cause of embarrassment or is disagreeable to the patient may have the same effect. In hyperesthetic women the uterine contractions may be so exquisitely

painful that their first onset is followed by an inhibitory impulse which cuts them short almost immediately. Every clinical observer has seen the phenomenon of rapidly recurring, very painful uterine contractions, which are, however, of short duration, and which secure no appreciable dilatation of the cervical canal. A woman may be tortured thus for hours in the early part of the first stage of labor, when this inhibitory nervous impulse is commonly observed. With the continuance of labor the individual becomes more or less indifferent to her surroundings or more inured to suffering, and the inhibitory nerves, probably derived from the spinal cord, apparently lose the power of responding to the stimulus of pain.

Among the mechanical causes of inefficient uterine action during labor are fibroid tumors of the uterine walls, displacements of the uterus, old peritoneal adhesions, and fresh outbreaks of periuterine inflammation.

Diagnosis.—The recognition of uterine inertia should always be easy. The contractions of the muscle are of short duration and are separated usually by long intervals, and by palpation the observer may convince himself that they are feeble. The uterus during the pain does not assume the hard consistency which it does in consequence of normal vigorous action. The patient's expression, action, and demeanor point to deficient force during the pains. The woman is more placid, the face is less contorted, and there is less outcry during the contractions than in the normal parturient patient, except in those cases in which excessive pain inhibits uterine action. In these cases, however, abdominal palpation and the short duration of the pains are plain signs of the inertia. Finally, labor is delayed. During the first stage dilatation is slow or does not progress at all, and in the second stage the presenting part does not advance. One fatal error in the diagnosis of inertia uteri should be avoided: the physician should be sure that labor is not delayed by some obstruction. It has happened in a careless and superficial examination that the observer has taken the distended and thinned lower uterine segment for an inert uterus. In such a case the measures adopted to stimulate the supposedly inactive uterine muscle to overcome an obstacle that is insuperable might easily be interrupted by rupture of the uterus. A methodical and careful examination avoids this error. The source of obstruction is discovered. The firmly, perhaps tetanically, contracted upper uterine segment may be contrasted with the inactive lower segment by palpation of the whole anterior surface of the uterus. The contraction-ring should be visible, and the whole uterus stands out with unusual prominence, from

the anteversion that always accompanies prolonged and powerful uterine contraction.

Treatment.—From the diversity in the causes of inertia uteri it follows that no single plan of treatment can be depended upon. If uterine action is inhibited by emotion, the cause of nervous disturbance should, if possible, be removed. An objectionable person should leave the room. If excessive pain prevents effective contractions, an analgesic should be administered. Nothing is better for this purpose than chloral administered in 15-grain (0.97 gm.) doses, repeated, if necessary, twice at intervals of fifteen minutes. A quarter of a grain (0.0162 gm.) of morphin hypodermatically comes next in order of efficiency. If the uterine muscle is simply apathetic, it can be aroused by some direct irritant. The insertion of a bougie as for the induction of labor answers the purpose well. A more effective but more troublesome measure is the dilatation of the cervical canal by Voorhees' bags, which not only irritate the uterine muscle and so bring on strong contractions, but also artificially dilate the cervical canal and thus relieve the uterine muscle of a great part of its task in the first stage of labor. If the head is well engaged in the pelvis, however, the insertion of the bag is difficult, and it is likely to cause malpositions. In such cases, if the os is dilated to the size of a silver dollar, nothing is so effective as the application of forceps—not to drag the head through the undilated cervical canal, but to pull it at intervals firmly down upon the cervix. The impact of the head upon the cervix acts as a powerful reflex irritant, and excites as strong contractions as any direct irritant can do. Not only so, but the pull of the head upon the cervix gradually dilates the canal as effectually as could strong propulsion from above. As soon as effective pains are established and the dilatation of the cervical canal progresses satisfactorily, the forceps should be removed.

Inertia uteri so profound as to demand the somewhat radical measures just described is, fortunately, rare. More commonly the physician sees the minor grades, in which there is simply a flagging of uterine effort during the first stage, especially in primiparæ, accompanied by every evidence of temporary physical and mental exhaustion. After a period of rest effective contractions reappear, even if nothing whatever is done to aid the patient. The more complete the rest, the more vigorous is the uterine action when it is resumed, and for this reason the administration of chloral and opium is often followed, after a time, by a satisfactory progress in labor. But these drugs necessarily retard the termination of labor by the time of rest they

secure. It is ordinarily desirable, therefore, to resort to drugs of a stimulant character that shall at once revive the flagging uterus and so hasten the delivery. Many medicaments have been recommended for this purpose, but, of them all, alcohol, quinin, and ergot alone deserve consideration. The last was employed extensively at one time, but clinical experience forbids its use to-day. The contractions of the uterus induced by ergot are likely to become tetanic. The uninterrupted contractions interfere with the fetal circulation; they may cause fatal intra-uterine asphyxia, and they often produce such exaggerated blood-pressure and stagnation of the current in the fetal body as to induce extravasations in important viscera, especially the brain. Further, the circular fibers of the cervix come under the influence of the drug, and by their firm contraction neutralize the contraction of the longitudinal fibers of the uterine body, and thus retard labor almost indefinitely; and, worst of all, should there be some obstruction to the descent of the child in the maternal pelvis or in the fetal body, the administration of ergot predisposes to rupture of the uterus. For these sufficient reasons this drug, as a stimulant to the uterine muscle in the first and second stages of labor, should be banished from the obstetrician's pharmacopeia, except in the single instance of the birth of the second of twins. Owing to the recommendations of Albert H. Smith and of Fordyce Barker, quinin has had, and still has, a great reputation as a stimulant to the uterus in labor. My experience with the drug does not permit me to subscribe unreservedly to its efficacy as a uterine stimulant in labor. Quinin has the positive disadvantage, moreover, of occasionally producing a violent postpartum hemorrhage. It is, however, undeniable that in multiparæ, in the first stage of labor, 15 grains of quinin often proves a valuable uterine stimulant. In the minor grade of inertia under description, so often seen in primiparæ, and almost always the result of exhaustion, nothing is so useful as alcohol, in the shape of a wineglassful of sherry, taken slowly with a biscuit, and given with the positive assurance that it will bring back the pains and hasten the conclusion of labor, for the patient often needs moral and mental support as much as she requires a physical and muscular stimulus.

An impression prevails among general physicians that inertia uteri in the first stage of labor, before rupture of the membranes, may safely be disregarded. In a measure this view is correct. There is often a partial dilatation of the os and then an entire cessation of uterine contractions for many hours and even for days. I have seen one case in which the cervical canal was sufficiently dilated to receive four fingers, and it remained so for more than a week, the patient all the while going about on

her feet in perfect comfort, without a single painful contraction of the uterus. But should inefficient uterine contractions be accompanied by much pain, as happens in some cases of inertia, the long-continued first stage should not be regarded with indifference. The patient in time shows the irritant and depressant effects of long-continued suffering in an elevated temperature, an accelerated pulse, and a lessened resisting power of body-cells, the last playing an important rôle in the predisposition to sepsis after labor. Another consequence of delayed, painful labor may be seen in sensitive, nervous individuals who are at first thrown into a state of excitement and then from gloomy forebodings of harm to themselves and to their infants, pass into an almost maniacal condition of terror and dread.

It should be a rule of practice, therefore, to watch carefully all cases of inertia uteri, and to interfere as soon as the patient's mental condition or her pulse, temperature, and general vigor are demonstrably affected by the delay in labor.

Excessive Power in the Expulsive Forces of Labor.—An actual excess of power in the expulsive forces in labor sufficiently great to expel the fetus precipitately is extremely rare. A relative excess is not uncommon. The child's body may be so small, the pelvis so abnormally large, the maternal soft parts so relaxed, that the ordinary power exerted by the uterine and abdominal muscles is far in excess of that required to overcome the weak resistance offered, and the child is fairly shot out of the birth-canal. The rapid delivery may cause serious results to both mother and child. In the woman the structures of the pelvic floor may be lacerated severely; the sudden evacuation of the uterus predisposes to hemorrhage from inertia; the placenta may be detached prematurely; and the sudden evacuation of the abdominal cavity predisposes to dangerous syncope. For the child the chief danger is the possibility of unexpected delivery of the mother in the erect posture. The umbilical cord may rupture, and the child, falling to the ground, may be fatally injured. Precipitate and unexpected labors occur most frequently when women are seated upon the water-closet. The child is evacuated into the waste-pipe or down a well and may be destroyed. Some astonishing examples of infantile vitality, however, are furnished by such cases.

Unfortunately, the physician is usually not at hand to prevent a precipitate delivery and to avert its consequences. Should he find an infant descending the birth-canal with a rapidity dangerous to itself and to its mother, he can easily retard its progress by pressure with his hand against the presenting part.

Excess in the Resistant Forces in Labor.—Deformities of the Pelvis.—A comprehensive and satisfactory knowledge of deformities in the female pelvis has been gained only in the latter half of the nineteenth century, since the appearance of Michaelis' work in 1851.[1] Until the announcement by Arantius in the last quarter of the sixteenth century that a contracted pelvis is a serious obstacle in labor, the prevailing belief had been that difficult labors from mechanical obstruction by the maternal bones were due to a failure on the part of the pelvis to expand sufficiently for the passage of the child. This idea was entertained for a number of years after Arantius' time. According to Litzmann, Heinrich von Deventer (1651 to 1724) should be regarded as the real founder of our knowledge of the pelvis and its anomalies. He described the inclination of the pelvis, the axis of the pelvic inlet, the contracted pelvis, and the flat pelvis. Pierre Dionis was the first to point out (1718) the relationship between rachitis in childhood and a deformed pelvis in the adult. William Smellie's contributions to the study of the female pelvis were remarkably full and clear, when one considers how little was known before his time. His description of the rachitic pelvis, his reflections on its cause, and his accounts of illustrative cases may be read with profit to-day. Röderer, Stern, Cooper, Vaughan, Denman, Baudelocque, and Fremery added much to the stock of knowledge during the latter half of the eighteenth century. The men to whom we owe most of our present information about the pelvis and pelvimetry are Naegele, Kilian, Rokitansky, Michaelis, Robert, Litzmann, Neugebauer, and many others to whom reference will be made in the sections devoted to the particular varieties of deformed pelvis.[2]

Frequency of Deformed Pelves.—It is difficult to estimate the frequency in America of pelves sufficiently deformed to influence decidedly the course of labor. Statistics from our lying-in hospitals afford little aid to a correct conclusion, because the inmates are chiefly European immigrants and negresses. In the Boston Lying-in Hospital, however, deformed pelves were found in two per cent. of native-born and in six per cent. of foreign-born women (Reynolds).[3] The statistics of Williams in Baltimore and of Crossen in St. Louis give a frequency of about seven per cent. among the white women of large American cities. Among negresses deformities of the pelvis are almost three times

[1] "Das enge Becken."

[2] Litzmann, "Drei Vorträge über die Geschichte von der Lehre der Geburt bei engem Becken," in his "Geburt bei engem Becken," etc., 1884.

[3] "Trans. of the Amer. Gyn. Soc.," 1890, p. 367.

as frequent as in white women.[1] My experience in hospital and consulting practice convinces me that deformed pelves are by no means rare among native-born women in the densely populated centers of the Eastern States.[2] No general practitioner, in a large city at least, can hope to avoid such cases, and it is likely that each year will afford him one or more striking examples. It follows that an ability to recognize deformities of the female pelvis is a necessary accomplishment for every practitioner of medicine who may be called upon to attend women in confinement, and that a knowledge of pelvimetry is as essential to the intelligent and successful practice of obstetrics as are percussion and auscultation to the practice of medicine. European statistics bearing on the frequency of contracted pelves give the following results: Michaelis found in 1000 parturient women 131 contracted pelves; Litzmann, 149. Winckel found in Rostock 5 per cent., in Dresden 2.8 per cent., and in Munich 9.5 per cent. of contracted pelves among pregnant and parturient women. Winckel believes that 10 to 15 per cent. of child-bearing women have contracted pelves, but that in only 5 per cent. is the obstruction serious enough to be noticed. Kaltenbach puts the frequency of contracted pelvis at 14 to 20 per cent. In Marburg it was found to be 20.3 per cent., in Göttingen 22 per cent., in Prague 16 per cent. Schauta estimates it at 20 per cent. In French statistics the frequency is from 5 to 16 per cent.; in Austrian, from 2 to 8 per cent.; in Russian, from 1 to 5 per cent.

Classification of Anomalies in the Female Pelvis.—All classifications are merely a convenience for the teacher and student. It is rarely possible to draw sharply defined lines between varying manifestations of a condition. The majority of German authors follow Litzmann's classification of abnormalities of the female pelvis, by which they are broadly divided into those of size and those of shape. Modern French authors adopt the still less satisfactory division of oversize, undersize, and anomalies of inclination. Schauta's classification is, in my opinion, the most convenient, and I have utilized it, with a slight modification.[3]

[1] J. W. Williams, "Obstetrics," vol. i, Nos. 5 and 6.

[2] In the Maternity, the Philadelphia, the University Hospitals, and in the Southeastern Dispensary Service there have been over 15,000 births during my connection with these institutions. The proportion of deformed pelves is about the same as that found by Reynolds, Crossen, and Williams in their hospital statistics, so that I have had the opportunity of observing more than a thousand deformed pelves, including many of the rarest types. In my own private patients, however, I have hardly ever seen a deformed pelvis, and I imagine they are extremely rare in the healthy agricultural districts of America.

[3] Müller's "Handbuch."

ANOMALIES OF THE PELVIS THE RESULT OF FAULTY DEVELOPMENT.

Simple flat pelvis.
Generally equally contracted pelvis (justo-minor).
Generally contracted flat pelvis (non-rachitic).
Narrow funnel-shaped, fetal, or undeveloped pelvis.
Imperfect development of one sacral ala (Naegele pelvis).
Imperfect development of both sacral alæ (Robert pelvis).
Generally equally enlarged pelvis (justo-major).
Split pelvis.
Assimilation pelvis.

ANOMALIES DUE TO DISEASE OF THE PELVIC BONES.

Rachitis.
Osteomalacia.
New growths.
Fractures.
Atrophy, caries, and necrosis.

ANOMALIES IN THE CONJUNCTIONS OF THE PELVIC BONES.

Abnormally firm union (synostosis), which is found in elderly primiparæ, particularly at the sacrococcygeal joint and in the joints between the coccygeal bones :
Synostosis of the symphysis.
" " one or both sacro-iliac synchondroses.
" " the sacrum with the coccyx.
Abnormally loose union or separation of the joints :
Relaxation and rupture.
Luxation of the coccyx.

ANOMALIES DUE TO DISEASE OF THE SUPERIMPOSED SKELETON.

Spondylolisthesis.
Kyphosis.
Scoliosis.
Kyphoscoliosis.
Lordosis.

ANOMALIES DUE TO DISEASE OF THE SUBJACENT SKELETON.

Coxalgia.
Luxation of one femur.
Luxation of both femora.
Unilateral or bilateral club-foot.
Absence or bowing of one or of both lower extremities.

Diagnosis of Pelvic Anomalies; Pelvimetry.—Deformities of the female pelvis may be detected by the history of the patient, by her appearance, by palpation of the exterior and interior of the pelvis, and by external and internal measurements of the pelvic diameters that are accessible, or of salient points on the woman's body corresponding as nearly as possible with the internal measurements desired, the relations between the last two having been ascertained by many observations on dead and living bodies. It has been proposed to utilize the Roentgen rays in the diagnosis of pelvic deformities, but this method, while it shows anomalies of form, as in a Naegele pelvis,[1] is inferior to digital and instrumental pelvimetry in determining the extent of anomalies in size.[2] For taking pelvic measurements the examiner's fingers, a tape-measure, and a modified mathematician's calipers—a pelvimeter—are usually employed. Baudelocque (1775) was the first to devise the pelvimeter in ordinary use. He laid the foundations of pelvimetry; his instrument and methods are in use at the present time (Figs. 316–320). It is convenient to describe the measurements of the diameters of the pelvic inlet, pelvic cavity, and pelvic outlet separately.

Measurement of the Anteroposterior Diameter of the Superior Strait.—This measurement, the most important in the pelvis, can not be taken directly. It must be estimated by several plans. Baudelocque was the first to point out the relation between the measurement from the depression under the last spinous process of the lumbar vertebræ to the upper edge of the symphysis pubis, and the true conjugate diameter of the pelvic inlet. To this external measurement the name "external conjugate" was given, but it is often called "the diameter of Baudelocque" (Fig. 320). Its discoverer believed the relation between the external and internal diameters to be constant,—that the one exceeded the other by 8 to 8.75 centimeters,—but in this he was mistaken. The line of the external diameter does not usually coincide with the line of the internal, and the thickness of bones and superimposed structures differs, of course, in each individual. In thirty cases in which Litzmann had an opportunity to compare the measurement of the external conjugate taken during life with the actual measurement of the true conjugate taken after death, there was an average difference of 9.5 centimeters, but the maximum difference was 12.5 centi-

[1] Budin, "L'Obstétrique," 1897, p. 500.

[2] See Lewy and Thumin, "Deutsche med. Wochenshr.," 1897, No. 32; also Müllerheim, *ibid.*, No. 39. Bouchacourt and Fabre surround the pelvis with a rectangular metal frame with indentations 1 cm. apart, which, reproduced in the photograph, are said to enable one to estimate the size of the pelves. "L'Obstétrique," 1900, p. 320; Donnezan, "Thèse de Lyon," 1906.

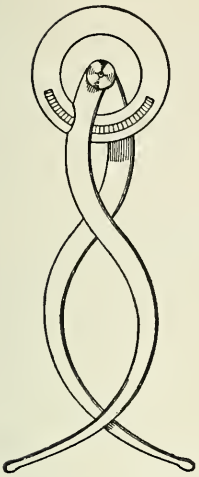


Fig. 316.—Osiander's pelvimeter.

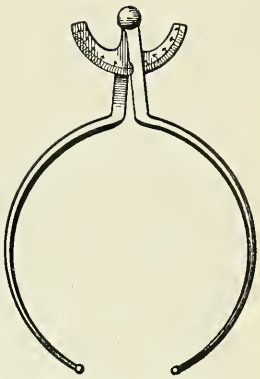


Fig. 317.—Modern combination of Baudelocque's and Osiander's pelvimeter.

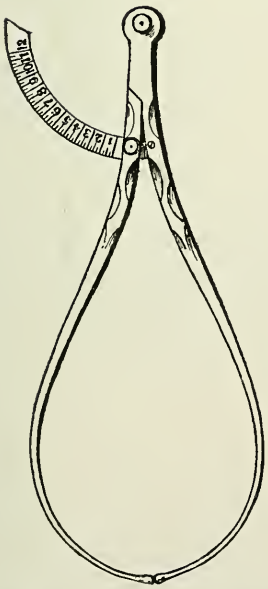


Fig. 318.—Martin's pelvimeter.

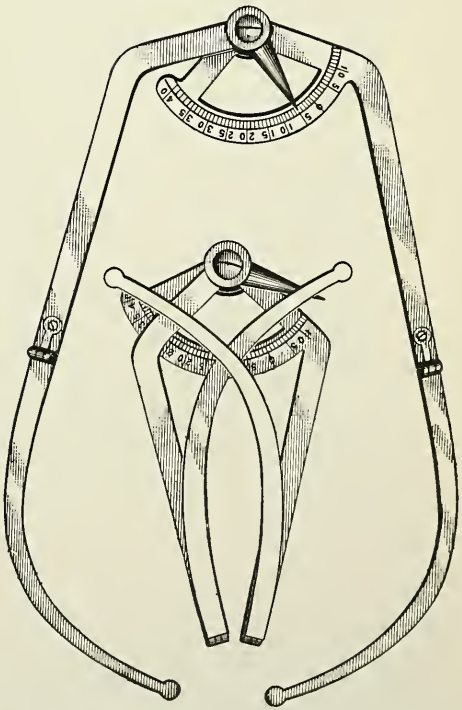


Fig. 319.—Harris-Dickinson portable pelvimeter.

meters and the minimum 7 centimeters,—a variation of 5.5 centimeters in a small number of cases. Michaelis found a difference of 0.6 to 3.2 centimeters and Schroeder 1.25 to 3 centimeters between the external conjugate of the living body and that of the dried specimen. The measurement of the external conjugate, therefore, is not to be relied upon in making an estimate of the size of the true conjugate. It simply serves to indicate the probability or the improbability of pelvic contrac-

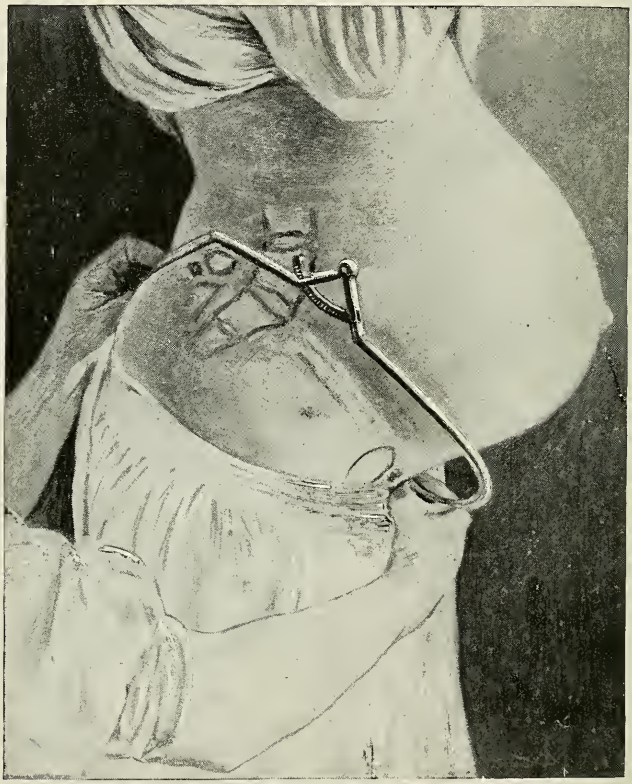


Fig. 320.—Measuring the external conjugate diameter upon the living female (Dickinson).

tion. An external conjugate of 16 centimeters or under means certainly an anteroposteriorly contracted pelvis; between 16 and 19 centimeters the pelvic inlet is contracted in more than half the cases; between 19 and 21.5 centimeters there are but ten per cent. of contracted pelves; and above 21.5 centimeters it is almost certain that the conjugate diameter of the pelvic inlet is not contracted at all. The external conjugate

can not be measured accurately without some practice. The beginner in pelvimetry will do well to remember the following rules :

Have the patient dressed for bed. Place her upon her side, with the thighs slightly flexed and the clothing rolled well up out of the way, the lower part of the body being covered with

Fig. 321.—Kite- or lozenge-shaped figure on the back, indicating position of the depression under the last lumbar vertebra and the posterior superior spines of the ilia.

a sheet. The examiner stands at the patient's back, facing her head. The depression below the last spinous process of the lumbar vertebræ is found by rubbing a finger-tip over the lumbar spines from above downward until the finger sinks into the depression sought and feels no more prominent spinous processes

below.[1] Occasionally this point is perceptible, a lozenge-shaped figure being made by the depression under the last lumbar vertebra, the posterior superior spines of the ilium, and the tip of the sacrum (Fig. 321). The knob at the end of one branch of the pelvimeter is placed firmly in the depression under the spinous process of the last lumbar vertebra, and is held there with one hand, while the fingers of the other hand find a point on the symphysis pubis about ⅛ of an inch below its upper edge, on which point the other branch of the pelvimeter is firmly set; the pelvimeter is so placed that the indicator is turned toward the examiner; the measurement is therefore easily read off as

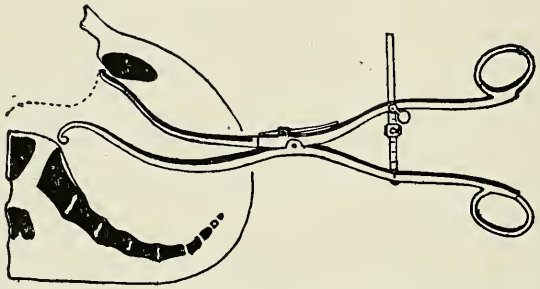


Fig. 322.—Stein's instrument for direct measurement of the conjugate.

soon as the pelvimeter is in proper position. It is on the average, in well-built women, 20¼ centimeters.

The best measurements for determining the length of the anteroposterior diameter of the pelvic inlet are those taken from the lower edge of the symphysis pubis to the promontory of the sacrum,—the diagonal conjugate diameter,—and the distance between the upper outer surface of the symphysis pubis and the promontory of the sacrum. The diagonal conjugate diameter is one side of a triangle, the other two sides of which are the height of the symphysis and the true conjugate. The distance between the outer upper surface of the symphysis and the promontory of the sacrum differs from the true conjugate by the thickness of the upper portion of the symphysis. Smellie was accustomed to estimate roughly the length of the true conjugate by a digital examination, basing his estimate on the ease with which the promontory could be reached. In the latter part of the eighteenth century Johnson [2] proposed, for estimating the

[1] Michaelis preferred the measurement from the tip of the last lumbar spinous process, instead of from the depression below it.

[2] Robert Wallace Johnson, "A New System of Midwifery," etc., London, 1769.

size of the pelvic inlet, a method which consisted of inserting the fingers of one hand in the mouth of the womb and then spreading them between the promontory and the sacrum. A few years later the elder Stein devised a graduated rod for measuring the distance between the lower edge of the symphysis pubis and the division between the second and third sacral vertebræ. This distance he believed to be one-half to one inch greater than the true conjugate. Stein later constructed the instrument for the direct measurement of the conjugate shown in figure 322. Many instruments have since been constructed on this principle, but they are impracticable in the living female, for obvious reasons. Baudelocque was the first to propose the measurement of the diagonal conjugate and the subtraction from it of an average figure (half an inch) to determine the length of the true conjugate. His method, exactly as he described it, is still in use, with the exception that two fingers instead of one are employed in measuring the distance between the symphysis and the promontory. To measure the diagonal conjugate correctly, the examiner must have the skill that comes of practice, and he must conduct his

Fig. 323.—Measuring the diagonal conjugate diameter (Dickinson).

examination in a careful and methodical manner. The patient is put in the lithotomy position and is brought to the edge of the table or bed on which she lies, so that the buttocks project well over it. The examiner, with a sterile rubber glove upon his left hand, anoints the first two fingers with an unguent; he then inserts these fingers, held stiffly extended, inward and upward, until the tip of the second finger finds and rests upon the promontory of the sacrum. Care must be exercised not to take the last lumbar for

the first sacral vertebra or vice versa, nor the second for the first sacral vertebra—mistakes easily made in cases of so-called "double promontory." With the tip of the second finger resting firmly in place upon the middle line of the promontory, the radial side of the hand is elevated until the impress of the arcuate ligament under the lower edge of the symphysis is plainly felt upon it. With a finger-nail of the other hand a mark is made upon this point of the examining hand, which is then withdrawn (Fig. 323). The distance between this mark and the tip of the middle finger held extended is taken by a pelvimeter. This distance is the diagonal conjugate. By the observation of many subjects, alive and dead, an agreement has been reached that 1.75 centimeters should be subtracted from the diagonal conjugate to obtain the true conjugate diameter.

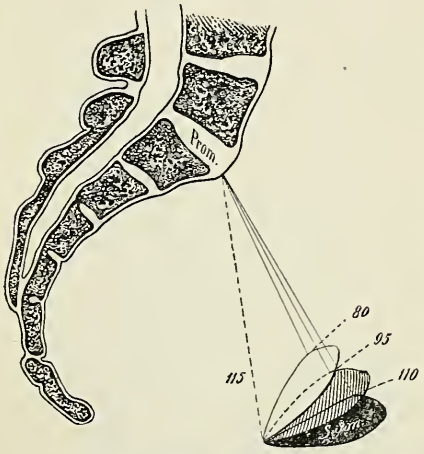


Fig. 324.—Effect of different inclinations of the pubis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

But the acceptance of this average difference depends upon a normal height of the symphysis, 4 centimeters; a normal angle between the axis of the pubis and the true conjugate, 105°; a normal thickness of the symphysis, and a normal height of the promontory (Figs. 324 to 328). These factors, however, are not constant, and if they vary much from the normal, the most skilful and most experienced obstetrician may be woefully misled in his estimation of the true conjugate. I have had under my care a rachitic dwarf in whom there was more than 3 centimeters' difference between the diagonal and true conjugates, and Pershing found, among ninety pelves in the museums of Philadelphia, a difference varying from 0.8 centimeters to 3.6 centimeters. It is declared that these sources of error may be eliminated by the following corrections: For every degree of increase in the conjugatosymphyseal angle add half the number of millimeters to the sum to be subtracted from the diagonal conjugate, and vice versâ; also, for every 0.5 centimeter increase in the height of the symphysis over the normal add 0.3 centimeter to the sum to be subtracted from the diagonal conjugate, and vice versâ. While these rules are admirable for the study of the dried specimen in a museum, they are not easily applied

to the living pregnant female. The height of the symphysis can be measured in the living subject, but an allowance for

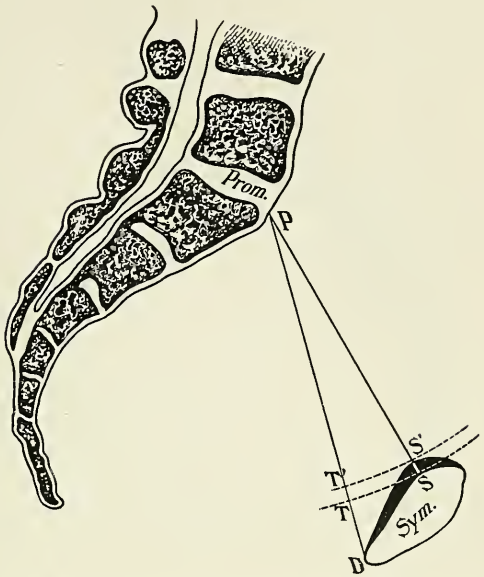


Fig. 325.—Effect of different thicknesses of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

variations in this respect eliminates error in only a small proportion of cases. The variations in the angle of the symphysis, a much more important source of error, can only be surmised. In cases upon the borderline between the relative and absolute indications for Cesarean section in which the difference of a centimeter would decide one for or against the operation I prefer the measurement between the upper outer edge of the symphysis pubis and the promontory of the sacrum for the

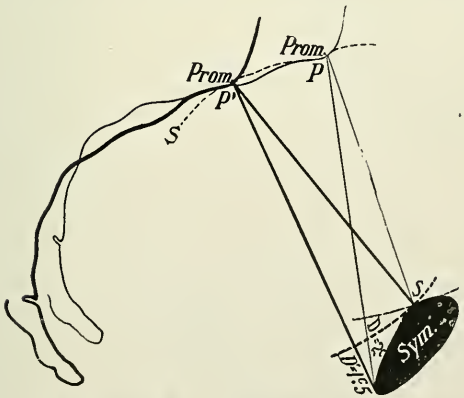


Fig. 326.—Effect of different heights of the promontory upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

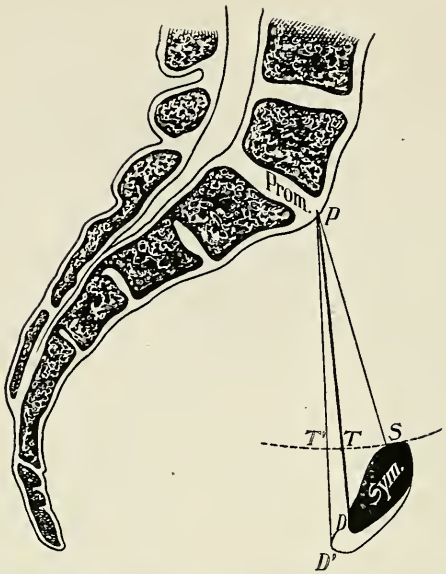


Fig. 327.—Effect of different heights of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

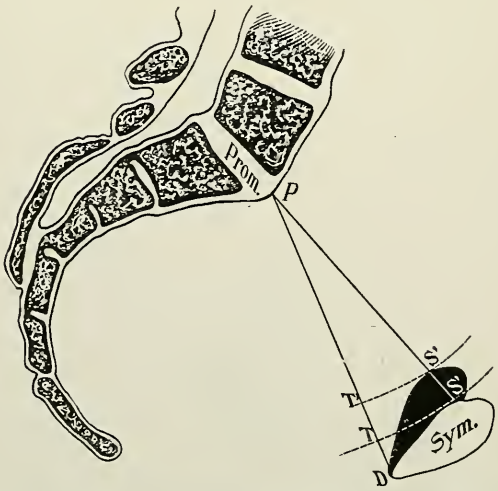


Fig. 328.—Effect of the lessened slant outward of the symphysis in a rachitic pelvis upon the relationship between the true and the conjugate diameter (Ribemont-Dessaignes).

estimation of the true conjugate, having demonstrated its superior accuracy in practice. For taking this measurement the patient is put in the dorsal posture, with the buttocks projecting beyond the edge of the table or bed on which she lies. A mark with the point of a lead-pencil is made on the skin over the symphysis pubis, about 1/8 of an inch below the upper edge. The two fingers of the left hand are inserted in the vagina, as in measuring the diagonal conjugate. The tip of the middle finger, having found the middle line of the promontory, is moved a little to the patient's right, and tip *b* of the pelvimeter, shown in figure 329, is made to take its place. While the examining physician holds the shaft of the pelvimeter firmly in

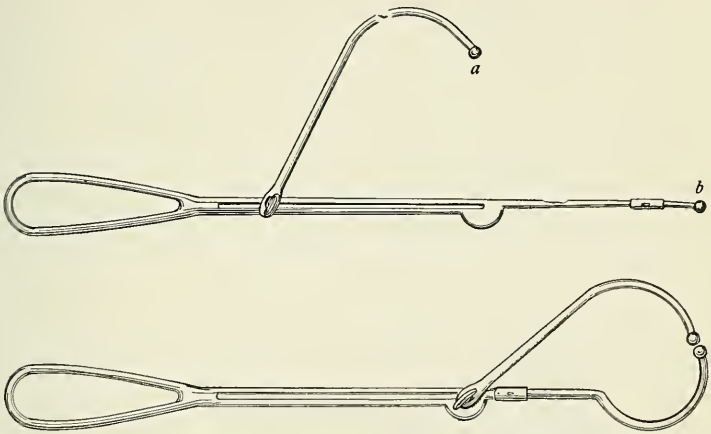


Fig. 329.—Author's pelvimeter: *a*, For measuring the true conjugate plus the thickness of the symphysis; *b*, with extra tip added for measuring the thickness of the symphysis.

place, an assistant adjusts tip *a* of the movable bar over the mark made on the symphysis. This bar is then screwed tight, the whole pelvimeter is removed, and the distance between the tips is found by a tape-measure. This distance is the conjugate plus the thickness of the symphysis (Fig. 330). The latter I have found to be 1 centimeter in twenty-six dried pelves, 1 1/4 centimeters in nine, 1 1/2 centimeters in thirteen, 1 3/4 centimeters in four, and 2 centimeters in three specimens—one a high-grade rachitic pelvis, another of the masculine type, and the third a justomajor pelvis. The thickness of the symphysis is measured as shown in figure 331. In living subjects the index-finger of the left hand must find the inner surface of the symphysis pubis, and must follow it up to within about 1/8 of an inch

of the top, where it bulges to its full thickness. On this point one tip of the pelvimeter is placed, and it is then held in position between the ends of the first and second fingers; the other tip of the instrument is adjusted over the mark made on the skin

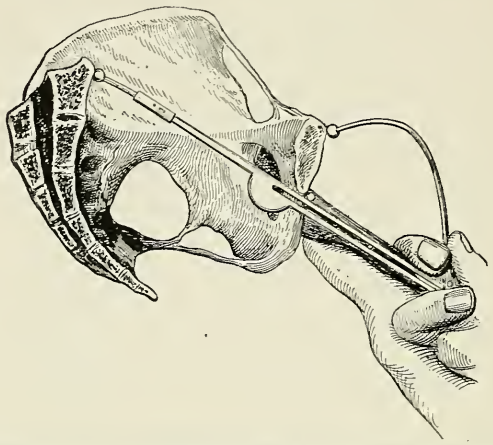


Fig. 330.—Measuring the true conjugate, plus the thickness of the symphysis, with the author's pelvimeter.

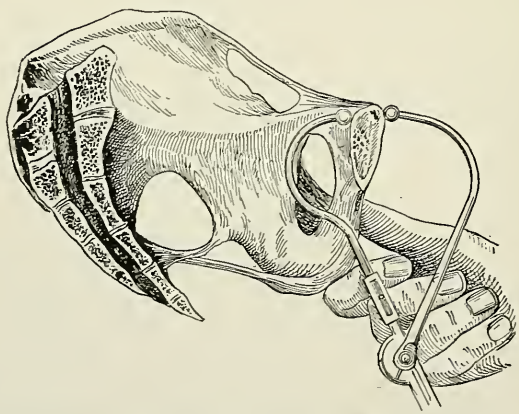


Fig. 331.—Measuring the thickness of the symphysis, with the author's pelvimeter.

externally; the distance is read off from the indicator provided for the purpose. It is not necessary to make an allowance for the thickness of the tissues over the symphysis, for this is included in both measurements, and on subtracting one from the other the necessary correction is made. The tissues over

the inner surface of the symphysis can usually be so compressed by the knob of the pelvimeter as to be practically eliminated. If this is impossible, as may happen in some primiparæ, a small allowance may be made for these tissues—say, at the most, 0.5 centimeter. In measuring a pelvis by this method it may be necessary to anesthetize the patient; and this is well worth while if a decision between some of the more serious obstetrical operations is to be based, as it must be, upon an accurate estimation of the true conjugate.[1]

Farabeuf has invented an ingenious pelvimeter for the direct mensuration of the true conjugate (Fig. 332). Its only fault is the danger of traumatism to the vesical mucosa from the intravesical

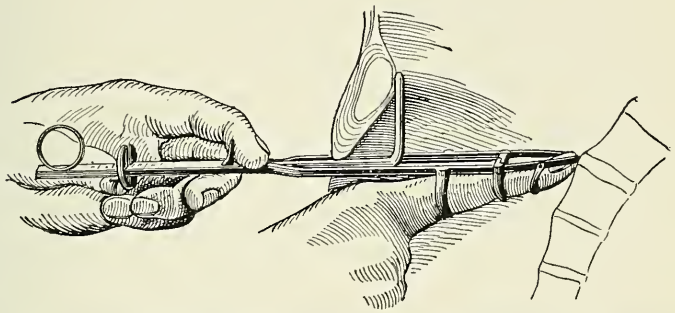


Fig. 332.—Farabeuf's instrument for measuring the true conjugate. The detachable retrosymphyseal bar is inserted in the bladder.

bar, which must be firmly pressed against the inner surface of the symphysis.

v. Bylicki[2] has devised a series of angulated metal rods for the direct measurement of the true conjugate (Fig. 333). The author has no experience with them.

Neumann and Ehrenfest have devised ingenious instruments (Figs. 336 *a*–336 *e*) for directly measuring the internal pelvic diameters, for finding the inclination of the pelvis, and for graphically recording the results obtained. The author has tried these instruments, but has found them so difficult to use without much practice and expert assistance that they are only practicable in a well-equipped clinic and are only needed in rare cases.

[1] Wellenbergh was the first to employ this principle in pelvimetry. His pelvimeter was improved upon by van Huevel, and in recent times by Skutsch and by Bullitt ("Deutsche med. Wochen.," No. 13, 1890; "Amer. Jour. Obstetrics," 1893; Müller's "Handbuch der Geburtshülfe," vol. ii, pp. 255, 260, 261).

[2] "Monatshr. f. Geb. u. Gyn.," vol. xx, 1904.

Ahlfeld, Zweifel, and Jastrebow have also devised instruments for exact pelvic measurements.[1]

Measurement of the Transverse Diameter of the Superior Strait.—The transverse diameter of the pelvic inlet can not be measured directly, nor can it be estimated accurately. Fortunately, it is not necessary to do it. It is sufficient to determine whether there is a decided diminution of the measurement, without determining the exact degree of lateral contraction. To do this the following measurements are relied upon: The

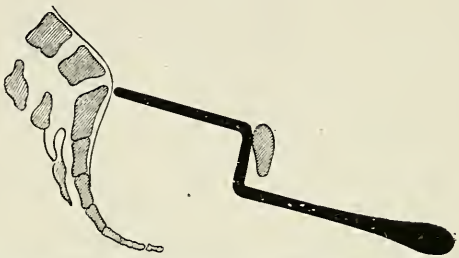


Fig. 333.—v. Bylicki's pelvimeter for measuring the conjugate directly.

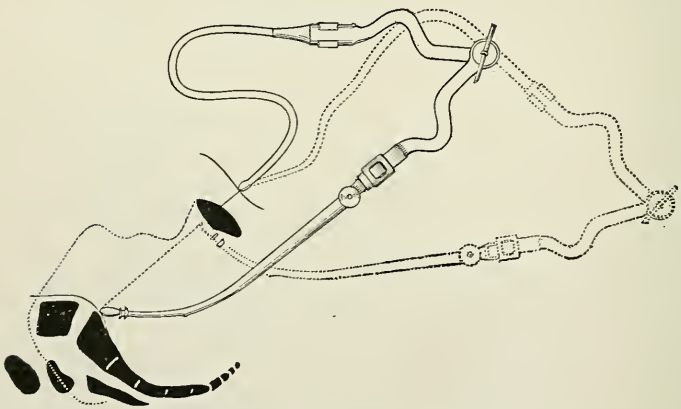


Fig. 334.—Skutsch's method of measuring the conjugate diameter.

distance between the anterior superior spinous processes of the iliac bones, which in well-formed women is 26 centimeters; the distance between the crests of the iliac bones, 29 centimeters; the distance between the trochanters, 31 centimeters; the distance between the posterior superior spinous processes of the iliac bones, 9.8 centimeters; the distance between the subpubic

[1] "Samml. klin. Vorträge Gyn.," No. 161, 1906; "Zentralbl. f. Gyn.," Nos. 4 and 27, 1906.

ligament and the upper anterior angle of the great sacrosciatic notch, which, according to Löhlein, is 2 centimeters less than the transverse diameter of the inlet; finally, an estimation of the width of the pelvic inlet by a vaginal examination. In taking the external measurements the woman is placed upon her back. The salient points are easily found except in the case of the iliac crests. They are discovered by moving the knobs of the pelvimeter evenly along the crests of the ilia until the two opposite points most widely separated from each other are found. If the crests are no further, or even less, separated from each other than the spines, points five centimeters back of

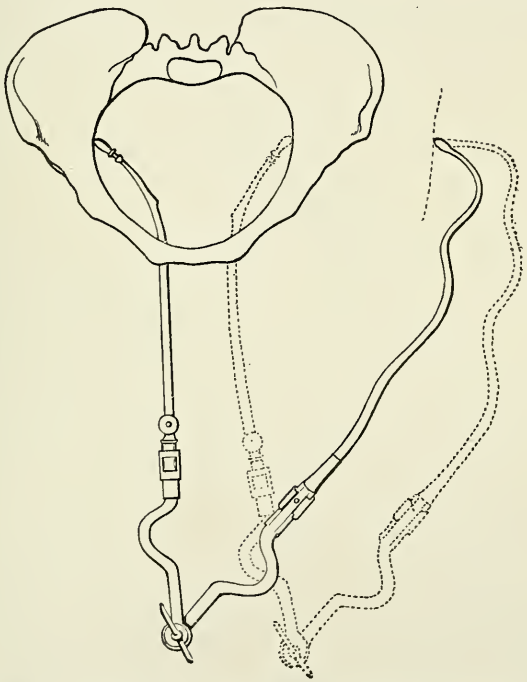


Fig. 335.—Skutsch's method of measuring the transverse diameter of the pelvic inlet.

the latter are arbitrarily selected as the sites of the crests. The posterior superior spinous processes are often marked by distinct dimples on the woman's back. The internal measurement of Löhlein is made by the fingers in the vagina. If all these measurements are much less than normal, a lateral contraction of the pelvis may be assumed, and the degree of contraction is roughly estimated by the amount of decrease in the measurements, although the relation between these measurements and the distance sought is

very variable. The efforts of Skutsch and of others before him, accurately to measure the transverse diameter of the pelvic inlet by combined internal and external measurements, have not yet been crowned by success. The softness of the tissues externally permits the external knob of the pelvimeter to sink into the flesh to a varying degree, and the same is true of the structures within the pelvis. It is difficult also to keep the pelvimeter in the same straight line when the internal knob is changed from one side to the other (Figs. 334 and 335). Moreover, better results in practice may be obtained by an estimate formed by a vaginal and a combined examination, under anesthesia if necessary, of the relative size of the transverse diameter of the pelvic inlet and the anteroposterior diameter of the child's head.

Measurement of the oblique diameters of the pelvic inlet is required

Fig. 336.—Measurement of the anteroposterior diameter of the pelvic outlet.

only in obliquely contracted pelves. It will be referred to in the description of these pelves.

The Measurement of the Capacity of the Pelvic Cavity.—The capacity of the pelvic cavity must be estimated by vaginal examination. There is no plan by which accurate measurements can be made. It is sufficient to estimate the size and the shape of the pelvic canal by palpating the lateral walls of the pelvis; by determining the curve, perpendicularly and laterally, of the sacrum; by noting the height of the sacrosciatic notches, the approximation of the tuberosities of the ischia, the depth of the pelvis, and the direction of its canal; by detecting, possibly, the presence of an exostosis, an osteosarcoma, an abnormally projecting spinous process, an old fracture, or asymmetry of the pelvic walls from any cause.

Measurement of the Transverse Diameter of the Pelvic Outlet.—The anteroposterior diameter of the inferior strait is enlarged

FIGS. 336 *a*–336 *e*.—NEUMANN AND EHRENFEST'S PELVIGRAPH AND KLISEOMETER. (*Amer. Jour. Obstet., No. 5, 1903.*)

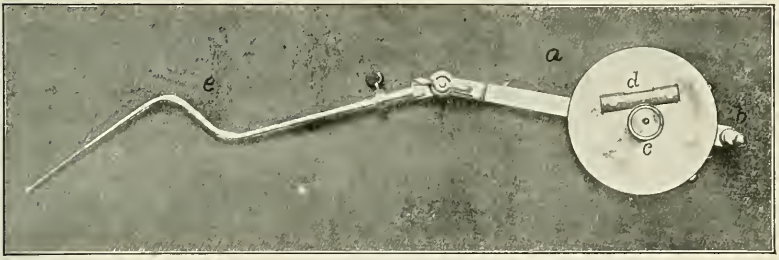


FIG. 336 *a*.

Fig. 336 *a*.—The pelvigraph : *e*, Arm for the promontory; *a*, extrapelvic portion; *b*, marker; *c*, screw; *d*, spirit-level, to keep successive lines on the pelvis horizontal.

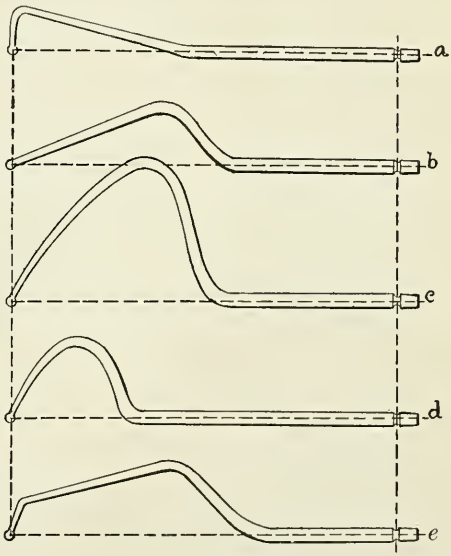


FIG. 336 *b*.

Fig. 336 *b*.—Detachable arms for the pelvigraph : *a*, For the symphysis ; *b*, for the promontory and upper sacrum; *c*, for the lower sacrum; *d*, to be used in case of a rigid perineum ; *e*, arm for measuring the transverse diameter of the pelvic inlet.

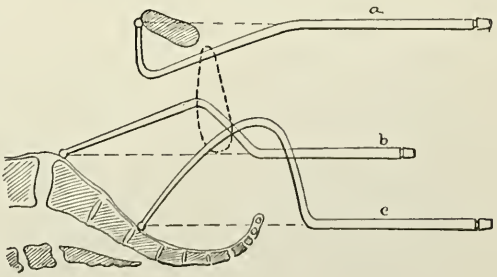


FIG. 336 *c*.

Fig. 336 *c*.—Measurements of the pelvis in successive horizontal lines.

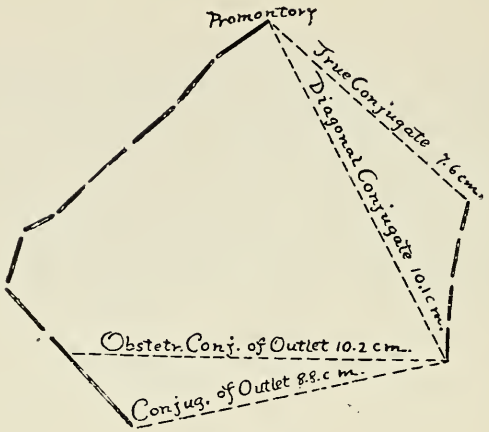


FIG. 336 *d*.

Fig. 336 *d*.—The contour and dimensions of a pelvis anteroposteriorly, plotted out by the marker (*b*) on a board fastened to the foot of the examining table.

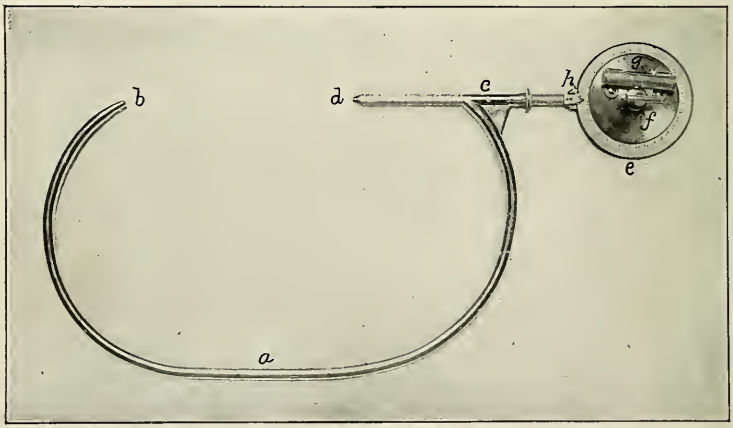


FIG. 336 *e*.

Fig. 336 *e*.—The kliseometer for determining the inclination of the pelvis: *a*, Rigid arch, between the patient's thighs in the erect posture; *b*, anterior knob; *d*, posterior knob; *c*, hollow rod; *h*, indicator; *g*, spirit-level; *e*, rotary disk. By determining the inclination of the inferior strait and arranging the plotted figure accordingly, the inclination of the superior strait is determined.

The principle of these instruments is irreproachable. They are indispensable in the accurate scientific study of an unusual case.

during labor by the displacement backward of the coccyx. The transverse diameter between the tuberosities of the ischiatic bones is constant, and if there is contraction of the outlet the greatest resistance to the escape of the fetus is furnished by these firm bony eminences. The transverse diameter of the pelvic outlet can be measured directly with ease. The woman is placed in the dorsal posture, with thighs and legs flexed. The distance between the tuberosities of the ischia is measured with a pelvimeter, or the examining physician places his thumbs squarely on the tuberosities, and an assistant measures the distance between the physician's thumb-nails.

Williams has devised a convenient pelvimeter for this measurement with rings at the tips to accommodate the thumbs. W. R. Nicholson has devised a telescopic rod with buttons on the end and a graduated scale, which is the best instrument for the purpose.

If it should be desired to measure *the anteroposterior diameter of the pelvic outlet*, this may be done as is shown in Fig. 336, 1.5 centimeters being subtracted for the thickness of bone and superimposed structures, or the extended first and second finger of the left hand may measure the distance from the lower edge of the symphysis pubis to the tip of the sacrum.

It is customary to neglect the measurements of the pelvic outlet except in those varieties of deformed pelves in which contraction of the transverse diameter may be expected, as in the funnel-shaped pelvis and in kyphosis. This practice may be said to be justified by clinical experience. In considerably more than a thousand deformed pelves in the hospital services under my care during twenty years I have seen serious obstruction at the outlet not more than five or six times. Williams, of Baltimore, however, states that he finds a contracted outlet in 8 per cent. of the women examined, or that one woman in twelve has a decided contraction (8 cm. or less) of the transverse diameter. If this statement should hold good for other localities, contraction of the outlet may be regarded with indifference unless it is much below 8 cm., for in the vast majority of cases the clinician will see no difficulty in labor from it.

Antepartum Fetometry.—The measurements of the pelvis are only important in their relationship with fetal measurements. A normal pelvis may be an insuperable obstruction in labor if the child is overgrown. A contracted pelvis may be no obstacle if the child is small. It is important, therefore, to measure or estimate the size of the fetal body, especially the head, before labor in estimating the difficulty to be expected and in selecting the proper treatment. Several methods may be employed. *Müller's method:* The head is seized between the fingers of the outspread hands

and is pressed downward into and if possible through the superior strait. If it enters readily there is no disproportion between the fetal head and the maternal pelvis. *Perret's method:* With a specially devised instrument the accessible diameters of the head are measured (the occipitofrontal); a fold of the abdominal wall is pushed together and measured. The measurement is subtracted from the first. *Stone's modification:*[1] The occiptofrontal diameter is measured through the abdominal wall, with the ordinary pelvimeter; no deduction is made for the thickness of the abdominal wall; 2 cm. is subtracted from the occipitofrontal to find the biparietal in heads with an occipitofrontal diameter of 11 cm. or less, or 5 cm. is subtracted if the occipitofrontal is more than 11 cm.

The author has always employed and prefers the following method: As the head lies transversely at the pelvic brim, it is pressed firmly down upon the brim as in Müller's method; the protrusion of the anterior parietal eminence beyond the upper edge of the symphysis pubis is estimated or actually measured; the true conjugate diameter of the pelvis is estimated; by adding the former to the latter measurement, less half the thickness of the symphysis, the biparietal diameter of the fetal skull is found. As a matter of fact mere figures in the measurement of the head mean little, but if the anterior parietal eminence projects 1 cm. beyond the symphysis with the fetal head lying transversely and pressed firmly down upon the pelvic inlet spontaneous engagement can not be expected.

Description of the Several Varieties of Abnormalities in the Female Pelvis.—The simple flat pelvis (Fig. 337). is the earliest recognized form of contracted pelvis—the *pelvis plana* of Deventer, who did not, however, make a distinction between the simple flat and the rachitic flat pelvis. It is doubtful, indeed, if he knew the difference between the two. Betschler was the first to point out the distinctive features of this form of pelvis. In Europe it is the commonest variety of deformed pelvis. Schröder states that it is seen more frequently than all the other forms put together. In America it is also common, but the equally generally contracted pelvis is encountered here as often or perhaps oftener. Out of a series of 316 pelves in women of American birth, I have found eighteen (a percentage of 5.6) with the measurements characteristic to some degree of a simple flat pelvis.

Characteristics.—In the simple flat pelvis the sacrum is small and is pressed downward and forward between the iliac bones, but is not rotated forward on its transverse axis. The antero-pos-

[1] "Medical Record," Nov. 4, 1905.

terior diameter is contracted, therefore, throughout the whole of the pelvic canal. The contraction, however, is not often great. It is scarcely ever below 8 and is usually not under 9.5 centimeters.[1]

The transverse diameter is as great as, or possibly greater than, that of the normal pelvis. Occasionally, however, in pelves approaching the type of the generally contracted flat pelvis the transverse diameter may be found somewhat diminished. There is in these pelves quite frequently a double promontory formed by the abnormal projection of the cartilaginous junction between the first and second sacral vertebræ. The line drawn between

Fig. 337.—Simple flat pelvis: C. v., 8½ cm.; tr., 13¼ cm.; obl., 12¾ cm.[2] (model in author's collection, University of Pennsylvania).

the lower promontory, or the second sacral vertebra, and the symphysis is often as small as, or smaller than, the true conjugate.[3]

Etiology.—The simple flat pelvis has been ascribed to heredity, to an arrested rachitis, to overwork before puberty (especially the carrying of heavy weights), to premature attempts to walk or to sit up, and to the weight of a heavy trunk upon a pelvis ill fitted to bear it on account of weakness of its ligaments. It is probable that in the majority of these pelves the form is inherited and congenital. It has been found by Fehling in a number of fetuses and new-born infants.

[1] Engelken has described a specimen with a true conjugate of 4.8 centimeters, a diagonal conjugate of 7.5 centimeters, with transverse and oblique diameters of the inlet 13.3 and 12.4 centimeters respectively. This specimen is unique.

[2] The abbreviations *c. v.*, *tr.*, and *obl.* will be used throughout to designate the true conjugate, the transverse, and oblique diameters of the pelvic inlet.

[3] Credé found, in nine pelves with a double promontory, the conjugate from the true promontory longer in four and shorter in three cases than the conjugate measured from the false promontory. In two cases the two conjugates were of equal length ("Klin. Vorträge über Geburtshülfe," Berlin, 1853).

Diagnosis.—The simple flat pelvis is easily overlooked. There is nothing in the patient's appearance or history to suggest the deformity, unless she has had difficulty in previous labors. The characteristic signs are the diminished anteroposterior diameter, determined by internal and external measurements, and a transverse diameter as great as, or greater than, normal, or perhaps a trifle under the normal measurement. This last point is determined by measurements externally and by the internal palpation of the pelvic canal. In measuring the conjugate diameter of the flat pelvis one must take into account the lessened inclination of the symphysis outward, its height, some-

Fig. 338.—The two conjugates of a double promontory: *Prom.*, True promontory; *F. P.*, false promontory (Ribemont-Dessaignes).

what below the normal, and the low position of the promontory. Usually the average sum of 1¾ centimeters is a sufficient amount to subtract from the diagonal conjugate. If there is a double promontory, as is frequently the case in this form of pelvis, the conjugate must be measured from the promontory nearest to the symphysis, usually the lower (Fig. 338).

Influence upon Labor.—From the failure of the presenting part to enter the pelvis during the last weeks of gestation there is frequently some degree of pendulous abdomen, especially in women with abdominal walls relaxed from previous pregnancies. The uterus is sometimes broader than common, and is often

tilted to one side. The presenting part, if the head, may be loose above the superior strait, resting on one iliac bone or on the symphysis, or it may be pressed down firmly upon the brim in a transverse position, to accommodate its longest diameter to the longest diameter of the pelvic inlet. Malpresentations are common, as is also prolapse of the cord and of the extremities. The membranes may protrude in a cylindrical pouch from the external os as the liquor amnii is forced out of the uterus without obstruction from the imperfectly engaged head. From the same cause an early rupture of the membranes is likely. According to Litzmann, natural forces end the labor in 79 per cent. of cases, but in 50 per cent. the head is not fully engaged until the os is completely dilated.

The later statistics of v. Boennighausen and Kissinger show a spontaneous termination by labor in a much smaller proportion of cases. According to the former, 36 per cent. in pelves with a conjugate above 8 cm., and none with a conjugate below 8 cm.; according to the latter, 85 and 17 per cent. respectively. The dilatation of the os proceeds slowly, for the head does not descend low enough to press upon the cervix. Consequently the dilatation must be affected by a retraction of the cervix over the head or by the distended membranes. Should the latter rupture, the os, although considerably dilated, may retract until the head at length descends and again dilates it. After the obstruction at the superior strait is passed,—where, of course, it is greatest,—the head usually descends the remainder of the birth-canal with ease and rapidity, but labor may be prolonged by an exhaustion of the natural forces in the attempt to secure engagement. The apparent anomalies in the mechanism of labor characteristic of this deformed pelvis are in reality the best possible provision for the spontaneous obviation of the obstruction. The transverse position of the head at the inlet, the increased lateral inclination, and the imperfect flexion are designed to accommodate the size and the shape of the head to the unnatural size and shape of the pelvic inlet. An explanation of these peculiarities in the engagement of the head may be found in the altered relation of expulsive and resistant forces. The head, forced down upon the flattened brim and free to move upon the neck, rotates until its longest diameter is adjusted to the greatest diameter of the inlet—the transverse. It seeks the direction of least resistance, as any inert body will when propelled through a contracted canal. But the transverse position of the head alone is not sufficient to overcome the obstruction. The biparietal diameter of the head is too large to enter the conjugate of the pelvis. The occiput, the bulkiest portion of the skull,

seeks the greater space to one side of the promontory, and is pushed against the lateral brim of the pelvis—the iliopectineal line. Here it is arrested. Further propulsion of the head is secured by a movement of partial extension, which brings the small bitemporal instead of the larger biparietal diameter of the head in relation with the contracted conjugate. Still, the obstruction may not be overcome. Both sides of the head may be unable to enter the pelvis at once. One side is propelled into the pelvic canal, the other is held back. That side which encounters the most resistance will naturally be the last to enter. Thus it is that usually the anterior parietal bone, slipping more easily past the symphysis, enters first. To this result also the inclination of the pelvic axis to the axis of the trunk contributes. Owing to the anterior position of the whole sacrum and to the diminished anteroposterior diameter of the pelvic outlet; on account, also, of the transverse position of the head and of its imperfect flexion, rotation of the head on the floor of the pelvis occurs late, and occasionally fails altogether, the head being expelled from the vulva in its original transverse or in an oblique position.

The localized pressure to which the maternal structures are subjected results sometimes in necrosis of cervical tissue over the promontory and of the anterior vaginal wall behind the symphysis. On the child's head the caput succedaneum is not exaggerated, because the head, when once firmly engaged in the pelvis, descends the birth-canal rapidly, but there is apt to be a depression on that portion of the skull applied to the promontory —namely, on the posterior parietal bone between the greater fontanel and the parietal eminence, usually quite close to the sagittal suture (Fig. 339). Sometimes a succession of these depressions or a gutter-shaped groove may be noted in a line running outward and forward on the child's skull. More frequently the course of the head and face over the promontory is marked by a red streak running from the depression before noted in a line parallel with the coronal suture toward the temple if the head is well flexed after engagement, or to the outer corner of the posterior eye, or, in case of extreme flexion, to the cheek (Fig. 340). Usually the posterior parietal bone is depressed below the anterior, which overlaps it at the sagittal suture. The posterior side of the skull is also flattened from the greater and more prolonged pressure to which it is subjected. Ordinarily the lateral inclination of the child's head is in a direction from before backward, so that the anterior parietal bone presents at the center of the superior strait. Occasionally this inclination is so

Fig. 339.—Depression in the parietal bone caused by the pressure of the promontory (Winckel).

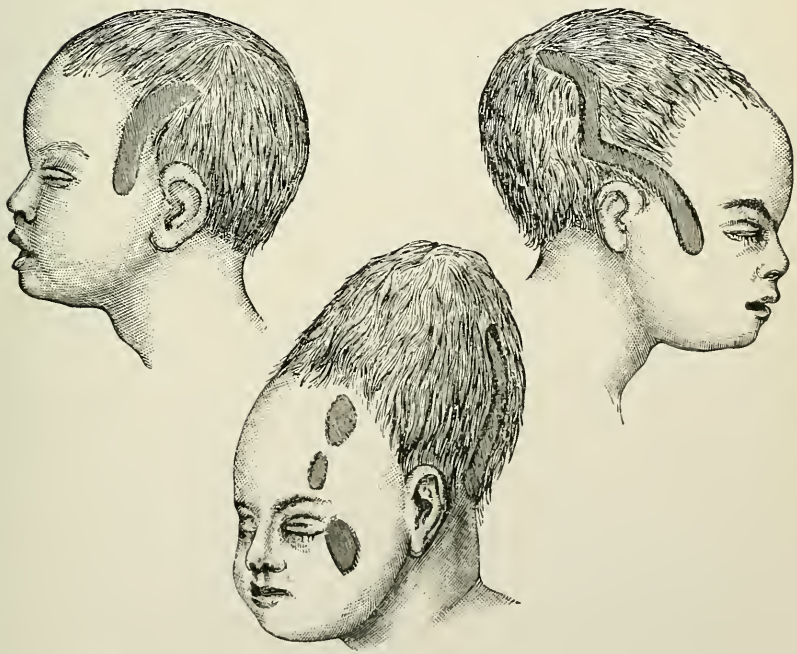


Fig. 340.—Marks made by the promontory on the child's head and face (Fritsch and Küstner).

exaggerated that the ear is the presenting part. Exceptionally the lateral inclination takes the opposite direction, the anterior parietal bone catches on the rim of the pubic bones, and the posterior parietal bone is the first portion of the child's head to enter the pelvis. The presentation of the posterior parietal bone occurs even in normal pelves as a rare exception, but is seen in about ten per cent. of contracted pelves (Schauta), and is the result in them very likely of firm abdominal walls and an increased inclination of the pelvic inlet to the axis of the trunk. In these cases the anterior parietal bone is pushed under the posterior at the sagittal suture. When the posterior side of the head by descent finds room in the hollow of the sacrum and moves backward, the anterior portion of the skull glides over the symphysis and the sagittal suture moves from its original position, just behind the symphysis, toward the median line of the pelvic canal. In addition to these anomalies of mechanism Breisky describes what he calls an "extramedian" engagement of the head in cases of flat pelvis in which there is considerable lordosis of the lumbar vertebræ. The head in extreme flexion is forced down upon half of the pelvic inlet, and enters the pelvic canal on this side alone. Directly the obstructing promontory and lumbar vertebra are passed the head descends the pelvic canal with rapidity and ease. This mechanism was noted nineteen times in Breisky's clinic among 2002 labors.[1]

Justominor Pelvis.—In this type of contracted pelvis the form of the female pelvis is preserved, but the size is diminished. Three divisions of this pelvis are commonly made: The *juvenile*, in which the bones are small and slender; the *masculine*, in which the bones are large, heavy, and thick; and the *dwarf*, or *pelvis nana*, in which the pelvis is very diminutive in size and the pelvic bones are not joined by bony union, but are separated by cartilage as in the infant. The innominate bones are divided into their three parts, and the sacral vertebræ are distinct from one another. The justominor pelves pass by insensible gradations into the simple flat, the transversely contracted, and the generally contracted flat pelves. In the larger cities of the United States the justominor pelvis is very frequently encountered. It is certainly as common here as is the simple flat pelvis, and if one were to judge from hospital patients, among whom there is a large proportion of shop- and factory girls,

[1] "Die Becken Anomalien," by Friedrich Schauta, in Müller's "Handbuch der Geburtshülfe," Bd. ii; Betschler, "Annalen der klinischen Anstalten," i, pp. 24, 60; ii, p. 31; Engelken, "Dis.-Inaug.," München, 1878; "Zur Kentniss der extramedian Einstellung des Kopfes," Kohn, "Prager Zeitschrift f. Heilkunde," Bd. ix.

this variety of contracted pelvis would be regarded as the commonest.

Characteristics.—While it is convenient to speak of the justominor pelvis as the normal female pelvis in miniature, the description is not strictly accurate. There are peculiarities due to an arrest of development which give to the equally generally contracted pelvis some of the features of an infantile pelvis. The alæ of the sacrum are narrower than they should be in comparison with the bodies of the vertebræ. The sacrum is short and is not pushed as far forward between the iliac bones as it usually is; it shows also a diminished forward inclination, and on its anterior surface a greater lateral and a less marked perpendicular concavity than common. The distance between the posterior superior spinous processes of the iliac bones is relatively great, on account of the posterior position of the sacrum and its slight rotation forward. The conjugatosymphyseal angle is greater than normal, by reason of the lessened inclination outward of the symphysis and the pubic bones. The promontory is high and not prominent, and the inclination of the pelvic entrance to the abdominal axis as the individual stands erect makes a more obtuse angle than it does in the normal pelvis. The bones in this form of contracted pelvis are commonly small and slender, except in the rare masculine pelvis, in which they are firm and thick beyond the normal. Women with a justominor pelvis are ordinarily of slight build and below the medium height; but this pelvis may be found in individuals of ordinary stature, and sometimes actually in tall women with a large frame.

The true dwarf pelvis is very rare. It is found only in women of dwarf stature. The bones are slender and fragile, and the cartilaginous junction between the original divisions of the pelvic bones is preserved. There is extreme contraction of the pelvic canal. While, strictly speaking, the dwarf pelvis is one in which there is an arrest of development and a failure of ossification in the junction of the three component parts of the innominate bones, there are three other types of dwarf pelvis in which there is extreme contraction of all the pelvic diameters: the cretin, the achondroplastic, and the hypoplastic. The distinctive differences between these types may interest the pathologist, but are of no importance to the obstetrician.

In the commoner kinds of justominor pelvis the contraction is not often very great. The conjugate diameter is seldom below 9 and scarcely ever as low as 8 centimeters. The pelvic outlet in some cases is laterally contracted; in others it is comparatively roomy.

Etiology.—The justominor pelvis is the result of arrested development; it may be found in women descended from a stock that has deteriorated physically, or in women subjected during childhood, infancy, or intra-uterine existence to unfavorable hygienic surroundings or conditions.

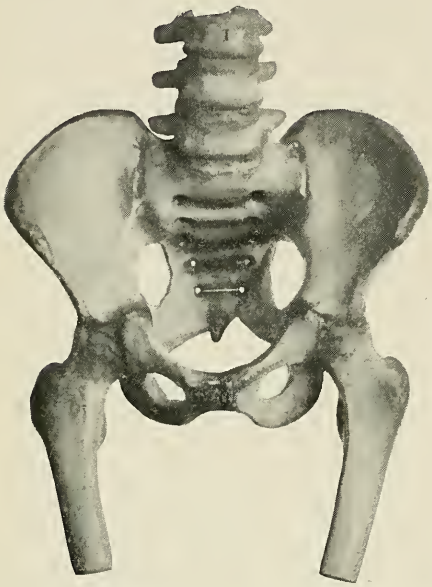


Fig. 341.—Dwarf pelvis (model in author's collection).

Diagnosis.—The justominor pelvis is easily confused with a rachitic pelvis, but the distinction is readily made by careful pelvimetry. All the measurements, while equally reduced, bear their normal proportion to one another, except in the case of the external conjugate diameter, which is apt to be longer than would be expected, on account of the posterior position of the sacrum and its lessened inclination forward. In estimating the true conjugate diameter from the diagonal conjugate one must often take account of the increase in the conjugatosymphyseal angle, and must remember that the sum to be subtracted from the diagonal conjugate is not infrequently greater than common. The symphysis is less in height than in the normal pelvis, but the error of computation from this source may be disregarded. Löhlein lays special stress upon the importance of measuring the pelvic circumference in making the diagnosis of this form of contracted pelvis. It is always far below the normal, ninety centimeters. An internal examination of the pelvic cavity and inlet should be made carefully, to determine approximately their capacity, with a special regard to the approximate length of the transverse diameters.

Influence on Labor.—The mechanism of labor shows far fewer anomalies in this than in any of the other forms of contracted pelvis. The head, from the greater resistance encountered, is strongly flexed. It may be placed transversely, but is quite commonly oblique, and may even be anteroposterior in position if there is a tendency to lateral contraction of the pelvic canal. By the perfect flexion of the head the obstruction to the

progress of labor is in great part obviated. If anything interferes with this movement of the head, as a faulty application of the forceps, engagement and descent may become impossible. Pelvic presentations in labor are a great disadvantage by reason of the difficulty experienced in freeing the arms and in bringing the head last through the generally contracted pelvic canal. To secure its rapid passage, the child's head must be flexed strongly by the operator's finger in its mouth before an attempt is made to secure engagement in the superior strait. While the woman escapes localized necroses of the soft tissues following labor in the justominor pelvis, there is greater likelihood of rupturing pelvic joints in this than in any other variety of contracted pelvis, and there is also an extraordinary liability to eclampsia (Fig. 342). The caput succedaneum, which is very large on account of the early fixation of the head and the long labor, is situated directly over the smaller fontanel. There is an overlapping of the cranial bones, both laterally and anteroposteriorly.

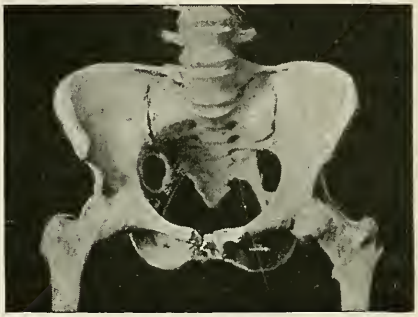


Fig. 342.—Justominor pelvis with ruptured pelvic joints, following forceps application: C. v., 9½ cm.; tr., 12½ cm.; obl., 11¾ cm. (author's collection).

The generally contracted, flat, non-rachitic pelvis presents the combined features of the flat and the generally contracted pelvis.

Characteristics.—All the diameters are below normal, but the conjugate is less in proportion than any of the others. This pelvis has many of the features of a rachitic pelvis, but the anterior half of the pelvic circumference is not markedly broadened; indeed, it is often the reverse. The sacrum is small and is not rotated on its transverse axis; it is placed further back between the innominate bones than in the normal pelvis, and very much further back than in the rachitic pelvis. The promontory is high and is not prominent. The influence of this deformity of the pelvis upon labor is that of a flat pelvis, but the difficulties are greater than in the case of the simple flat pelvis, for there is less compensatory room in a transverse direction. The generally contracted, non-rachitic, flat pelvis is comparatively rare. The flattening, according to Litzmann, is due to a shortening of the innominate bones, especially at the iliopectineal line. In estimating the true conjugate diameter of the generally contracted flat pelvis it is safer to subtract 2 instead of 1¾ cen-

timeters from the diagonal conjugate, on account of an increase in the conjugatosymphyseal angle, the result of the high position of the promontory and the diminished slant outward of the symphysis.

Etiology.—The generally contracted flat pelvis is due to hereditary influence or to an arrest of development in the embryo, fetus, or infant. It is claimed, however, that it may be produced by premature attempts to walk and by long standing upon the feet in very early life.

Diagnosis.—The recognition of a generally contracted flat pelvis is difficult. The measurements usually resemble those of a generally equally contracted pelvis, but the conjugate diameter is less than one expects in that form of contracted pelvis, and the mechanism of labor is that of a flat pelvis. The diagnosis can be made by finding the reduced conjugate diameter and by the ease with which one can reach the lateral pelvic wall in the palpation of the interior of the pelvic canal. A certainty of diagnosis can be obtained during life only by the direct measurement not only of the conjugate diameter, but also of the transverse, by the methods of Löhlein and of Skutsch.

The Narrow, Funnel-shaped Pelvis; Fetal or Undeveloped Pelvis.—This variety of pelvis is contracted transversely at the pelvic outlet, or both in the transverse and anteroposterior diameters, without abnormalities in the spinal column except an assimilation sacrum, with six instead of five vertebra. The depth of the pelvic canal is much increased by the length of the sacrum, of the symphysis, and of the lateral pelvic walls. The sacrum is narrow, has little perpendicular curve, and is placed far back between the ilia (Fig. 343). Schauta ascribes this form of contraction to an anomaly of development by which the pelvic walls are lengthened downward and the weight of the body is thrown backward upon the sacrum. Williams believes that in three-fourths of the cases it is due to a high assimilation sacrum. It is said to be very rare, but it has been found quite frequently in those hospitals where the outlet of the pelvis is regularly measured. It comprises from 5 to 9 per cent. of all contracted pelves, according to Breisky, and Fleischmann found twenty-four examples in 2700 parturient women.[1] Williams found that 8 per cent. of the pregnant women examined (573 in number) had this form of pelvis. A slight manifestation of the deformity is often called a "masculine" pelvis, by reason of the diminution in the breadth of the pubic arch. This degree of the funnel-shaped pelvis is frequently encountered (Fig. 344).

Diagnosis.—The diagnosis of a narrow, funnel-shaped pelvis is made by a comparison of the measurements of the pelvic inlet with those of the outlet. The former are found to be normal or

[1] "Prager Zeitschrift f. Heilkunde," Bd. ix, H. 4 and 5.

even greater than normal, while the measurements of the outlet are diminished. If, as is the rule in extreme degrees of this deformity, the inlet and cavity are contracted, the outlet is still smaller in proportion. A careful palpation of the pelvic canal is an important aid to a correct diagnosis. The pelvic walls are felt to converge as they approach the outlet; the narrowness of the pubic arch is appreciated, and the approximation of the tuberosities and spines of the ischiatic bones is noticeable.

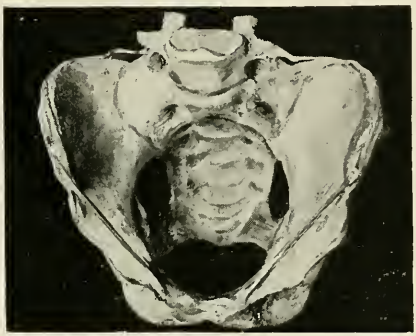


Fig. 343.—Narrow, funnel-shaped pelvis: C. v., 10½ cm.; tr. (inlet), 8¾ cm.; tr. (outlet), 7 cm.; ant. post. outlet, 7½ cm. (specimen in the author's collection).

Klein[1] pointed out the necessity of measuring what he calls the posterior sagittal diameter in these pelves. This is a measurement from a line drawn between the tuberosities of the ischia to the tip of the sacrum. A convenient method of measurement is suggested by Williams. A lead pencil of suitable length is placed between the tuberosities. A pelvimeter measures the distance between the center of the lead pencil and the external surface of the tip of the sacrum. One centimeter deducted from this measurement gives the posterior sagittal diameter. Williams is responsible for the statement that if there is lateral contraction (not specifying how much), and if the posterior sagittal diameter is below 8.5 cm., there is a positive indication for Cesarean section or pubiotomy. This statement must be confirmed or confuted by wider experience.

Fig. 344.—Minor grade of narrow, funnel-shaped pelvis with contracted pubic arch (from a plaster cast in the author's collection).

Influence upon Labor.—The peculiarities of mechanism in labor are malpositions of the head at the outlet (as backward rotation of the occiput), oblique and transverse position of the head, and imperfect flexion. There is also an insufficiency of the expulsive forces, the greater part of the fetal body being contained in the

[1] "Volkmann's Samml. klin. Vorträge," 1896.

lower uterine segment, cervix, and vagina, while the upper muscular segment of the uterus is in great part emptied and, therefore, powerless. By the approximation of the pubic rami the presenting part is forced backward, and serious lacerations of the perineum are to be feared. The pressure of the head upon the lower birth-canal may result in necrosis of soft structures or in lacerations along the descending rami of the pubis and the ascending branches of the ischium. The tissues over the projecting spines of the ischia are also the seat of tears or of necroses. The narrowing of the pubic arch may lead to serious injuries if forceps is applied. Lacerations in the anterior vaginal walls and profuse hemorrhage may follow the use of instruments. In well-marked examples of the narrow, funnel-shaped pelvis, with a transverse diameter at the outlet not much below 7.5 cm. (3 inches), pubiotomy gives the best chance of a successful termination for mother and child. Higher grades of contraction, with a diameter of 5 cm. (2 inches) and under, demand Cesarean section. In lesser grades the woman may be delivered spontaneously or by forceps.

Obliquely Contracted Pelvis from Imperfect Development of the Ala on One Side of the Sacrum (*Naegele Pelvis*).—This pelvis was first described in 1834 by Franz Carl Naegele,[1] but had been noticed as early as 1779 without a full understanding of its significance (Fig. 345).

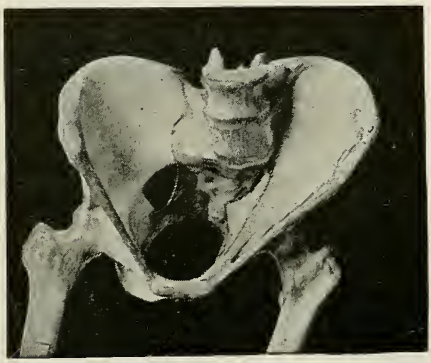


Fig. 345.—Obliquely contracted pelvis.

Characteristics. — The pelvic inlet has an oval shape, with the small point of the oval directed to the atrophied side of the sacrum. The sacral ala is atrophied or is absent not only in that portion of the bone entering the sacro-iliac joint, but also in the transverse process along its whole length. The sacro-iliac joint on this side is ankylosed in the vast majority of cases, but not invariably. The sacrum is narrow, asymmetrical, and turned with its anterior face toward the deformed side of the pelvis. The promontory is not only turned in this direction, but is also pulled over to the diseased side. The innominate bone on the

[1] "Die Heidelberger klinischen Annalen," Bd. x, p. 449. More elaborately described in his folio atlas, "Das Schräg verengte Becken, nebst einem Anhang über die wichtigsten Fehler des Weibl. Beckens Ueberhaupt," mit 16 Tafeln, Mainz, 1837.

deformed side is pushed as a whole upward, backward, and inward, and its anterior face is pushed inward and backward. The tuberosity of the ischium, as a necessary consequence of the displacement of the innominate bone, is higher than its fellow, projects further into the pelvic canal, and is so turned that it looks rather anteroposteriorly than laterally. The spine of the ischium is brought quite close to the corresponding edge of the sacral bone and juts prominently forward into the pelvic canal. The whole innominate bone on the diseased side lacks its normal curvature at the iliopectineal line, and may run almost straight from the sacro-iliac junction to the symphysis pubis. The opposite innominate bone has a greater curvature than common, especially in its anterior half; otherwise it is practically normal in structure, position, and inclination. The symphysis pubis is pushed toward the healthy side of the pelvis, and its outer surface, instead of looking directly forward, is inclined to the diseased side. The pubic arch likewise faces somewhat in this direction ; its aperture is asymmetrical and irregularly contracted, as the ischiac and pubic rami on the diseased side are pushed inward upon the pelvic canal and over toward the healthy side (Fig. 345).

Etiology.—The cause of the obliquely contracted pelvis under description is an absence of the bony nuclei in the ala or lateral process on one side of the sacrum. The lateral process consequently fails to develop, and the innominate bone is brought in relation with the bodies of the sacral vertebræ. As a result, there must be some distortion of the innominate bone even in fetal and infantile life, but this is increased to an exaggerated degree when the individual begins to walk. Instead of receiving the pressure from the lower extremity approximately on the keystone of an arch, as does a normally curved innominate bone, the deformed bone in a Naegele pelvis transmits the pressure in almost a straight line upward and backward, so that the extremity of the posterior arm of the arch slides past the sacro-iliac joint instead of resting firmly on it as an arch does on its abutments. The irritation and strain of this unnatural movement bring about in time the atrophy and ankylosis of the joint.

That the deformity in this kind of oblique pelvis does not follow a primary ankylosis of the sacro-iliac joint is proven by the fact that the innominate bone is pushed backward and upward on the sacrum—a movement that would be impossible were this joint first ankylosed. As a further proof of primary lack of development and secondary ankylosis, there is no trace of inflammation in or about the ankylosed joint, and the alæ or transverse processes of the sacrum are atrophied or are absent along the whole length of the sacrum, and not only in that

portion of it which enters into the composition of the sacro-iliac joint.

Diagnosis.—The recognition of an obliquely contracted pelvis from arrested development of the sacral alæ may be very difficult. There is nothing to direct the attention of the physician to the possibility of the deformity. There is no history of previous disease or of accident, no scar of an old fistula over the joint, and the patient does not limp. The diagnosis can be made only by a methodical external and internal palpation of the pelvis and by careful measurements. If the outspread hands are laid over the innominate bones, it is noticed that the dorsal surfaces are directed obliquely forward and backward as they lie upon the diseased and healthy sides. An internal palpation of the pelvis detects one lateral wall much nearer the median line than the other, and the diagonal conjugate is found to run not anteroposteriorly in direction, but from before backward and from the healthy to the diseased side of the pelvis. There are a number of points from which measurements may be taken that show inequalities where in the normal pelvis the distances should be the same or should differ by a very small sum. Naegele recommended the following measurements: (1) The distance of the tuber ischii on one side from the posterior superior spinous process of the ilium on the other; (2) from the anterior superior spinous process of one ilium to the posterior superior spinous process of the other; (3) from the spinous process of the last lumbar vertebra to the anterior superior spines of both ilia; (4) from the trochanter major of one side to the posterior superior spinous process of the opposite iliac bone; (5) from the lower edge of the symphysis pubis to the posterior superior spinous processes of the iliac bones. In addition to these measurements, others of value have been suggested by Michaelis and by Ritgen. These are the distances from the middle line of the spinal column to the posterior superior spinous processes of the iliac bones, and the distance from the lower edge of the symphysis to the ischiac spines, and from these spines to the nearest point on the edges of the sacrum. In this latter measurement it is found that the distance from the symphysis to the ischiac spine is longest on the diseased and shortest on the healthy side, while the distance from the ischiac spine to the edge of the sacrum is very much shorter on the diseased than on the healthy side. The last, which is a very important measurement, can easily be taken by laying finger-breadths between the points to be measured. As in all anomalies of form in the female pelvis, an x-ray photograph shows the condition often surprisingly well.

Influence on Labor.—The mechanism of labor in an obliquely contracted pelvis is, in the main, that of labor in a generally contracted pelvis. The shape of the pelvic entrance and canal is symmetrically ovoid, and the head can enter the contracted space only by extreme flexion. There are none of those anomalies of position, flexion, and inclination of the head which are seen in the flat pelvis. As the head descends the birth-canal, anomalies of mechanism may appear resembling those described in the narrow, funnel-shaped pelvis—namely, abnormal and

Fig. 346.—Pelvis of Naegele. Reproduction of an x-ray photograph taken from a living woman (Budin).

imperfect rotation and anomalies of flexion. Depending upon the degree of deformity, there is more or less interference with the progress of labor to complete obstruction. The head is almost invariably found entering the pelvis and passing through the canal with its longest diameter in coincidence with the longest oblique diameter of the pelvis, from the diseased sacro-iliac joint to the opposite iliopectineal eminence.

Prognosis.—In the recorded cases the results of labor in the Naegele pelvis have been bad. Of 28 women reported by Litzmann, 22 died in their first labor, 5 of them undelivered. Three

of these women died in consequence of their second labor, and 2 after the sixth. Out of 41 cases, 6 were delivered spontaneously, 12 by the forceps, 14 by craniotomy, 5 by version and extraction, 4 by premature labor, and 2 by Cesarean section. The following accidents were noted in the course of labor or shortly afterward: Rupture of the uterus or vagina, vesico-vaginal fistula, fracture of the horizontal ramus of the pubis, rupture of the sacro-iliac joint and of the symphysis. In another series of cases, 28 women furnished forty-two labors with the following results: 21 died as the result of the first labor, 3 of the second, and 1 after the sixth. These women were delivered seven times by craniotomy, once by Cesarean section, four times by premature labor, and in a number of instances by forceps. Out of 41 children in Litzmann's statistics, there were only 10 delivered alive, 2 of these by Cesarean section and 2 by premature labor. The 6 other living children were all born of the same mother.[1]

Treatment.—Forceps and version are not, as a rule, successful in the treatment of labor obstructed by an obliquely contracted pelvis unless the degree of deformity is slight. The induction of premature labor and the performance of Cesarean section are the most successful means of delivery, but the former should be resorted to only when the distance between the lower edge of the symphysis pubis and the sacro-iliac joint of the healthy side is not under 8.5 centimeters. In twenty forceps operations thirteen women died. The proposition of Pinard to do what he calls ischiopubiotomy has not met with favor. The room gained by the movement outward of the innominate bone on the healthy side, the other being, of course, immovable, will be sufficient only in pelves so slightly contracted as to allow a delivery by much simpler means.

Transversely Contracted Pelvis the Result of Imperfect Development of Both Sacral Alæ.—This pelvis was first described in 1842 by Robert, and is generally known as the "Robert pelvis" (Fig. 347). It is the rarest of all contracted pelves. Schauta was able to find but six examples recorded in child-bearing women. Ferruta has reported another case.[2] Herman gives eight as the number of recorded cases; Sonntag,[3] nine. The anatomical conditions are the same as in the Naegele pelvis, except that both sides of the sacrum are affected instead of one. Other parts of the sacrum besides the alæ may show imperfect development. There is a case reported in which the whole lower portion of the bone was absent. The sacrum in the Robert's

[1] The writer is indebted for these statistics to Schauta (*loc. cit.*).
[2] "Studii di Ostetricia e Ginecol.," Milan, 1890.
[3] v. Winckel's "Handbuch," 2^3, p. 1959.

pelvis is extremely narrow, and the posterior superior spinous processes of the iliac bones are brought close together. The degree of contraction in the transverse diameter is so extreme that natural labor is out of the question. An asymmetry of the Robert pelvis has been observed, one side showing a greater degree of the deformity than the other, and thus approaching the type of an obliquely contracted pelvis.

The *cause* of this deformity is an absence of the bony nuclei in the sacral alæ of both sides. Secondarily, as in the Naegele

Fig. 347.—Transversely contracted pelvis: C. v., 9¼ cm.; tr. (outlet), 5 cm.; tr. (inlet), 8 cm. (model in Mütter Museum, College of Physicians, Philadelphia).

pelvis, there is usually an ankylosis of the sacro-iliac joints. That this ankylosis is secondary and not primary is demonstrated by the same condition which proves that ankylosis is not a primary cause of the oblique contraction and ill-development of one side in the Naegele pelvis—namely, a displacement of the ilia on the sacrum necessarily occurring before the ankylosis.

The *treatment* of labor obstructed by a transversely contracted pelvis of this kind is Cesarean section.

Justomajor Pelvis.—A generally equally enlarged pelvis is found in women of gigantic stature, but it may also occur in a woman of medium height. The pelvis of the Nova Scotian giantess was large enough to give passage to a child weighing 28¾ pounds. The largest pelvis that has ever come under my notice was found in a woman somewhat below the average height, without an abnormally great development of any other portion of her frame.

Diagnosis.—The diagnosis of a justomajor pelvis is made mainly by external measurements. If all of them are found far in excess of the normal while preserving their normal relative proportion the diagnosis of a justomajor pelvis is justifiable.

The internal examination, if considered necessary, shows that the promontory is quite inaccessible, and that it is much more difficult than common to reach the lateral pelvic walls. This anomaly of the pelvis does not, of course, obstruct labor; on the contrary, it predisposes to precipitate delivery, although the resistance of the soft parts may be quite sufficient to delay the process considerably, even though the pelvis present no obstacle whatever. During pregnancy it is noted that the uterus has a tendency to sink deep within the pelvic canal, so that pressure-symptoms of the pelvic viscera and blood-vessels are common in the latter weeks of gestation, and these symptoms may become so exaggerated as to make locomotion difficult. In labor there may be anomalies in the mechanism dependent upon insufficient resistance to the engagement of the head. Thus imperfect flexion at the superior strait may be observed, and there may be a tardy rotation of the head on the pelvic floor.

Split Pelvis.—The split pelvis, which is due to a defect in the development of the lower portion of the trunk in front, is almost invariably associated with exstrophy of the bladder. This pelvis has very rarely been observed in the child-bearing woman; there are on record but seven examples complicating labor. The split pelvis presents no obstacle in parturition. There are the same peculiarities in labor as in the justomajor pelvis—namely, a tendency to precipitate birth, and anomalies in the mechanism the result of imperfect resistance. After labor it is almost certain that there will be a prolapse of the uterus. The *diagnosis* of this deformity presents no difficulties, and no obstetic treatment is called for in labor (Fig. 348).

The assimilation pelvis is of greater interest to the anatomist than to the practical obstetrician. It is characterized by an assimilation of the last lumbar vertebra to the type of the first sacral vertebra or vice versâ. The anomaly of development may affect one or both sides of the vertebræ. There may be an associated double promontory, some asymmetry of the pelvis, slight anomalies in the transverse, anteroposterior, and vertical diameters of the pelvis, but not enough disturbance of pelvic size and shape to influence labor seriously. According to Williams this is the most frequent cause of the funnel-shaped pelvis. It is only possible to diagnosticate an assimilation pelvis during life by a careful palpation of the sacral bones in a vaginal or rectal examination. It is not often practicable.

The Rachitic Pelvis.—In the healthy life and growth of bones two opposed processes are found: On the periphery there is an active proliferation of cells to form the bone-structure, while in the interior, bone-substance is being constantly absorbed by the marrow. In rachitis the absorption of bone-substance goes on

more rapidly than it does in healthy bone, and at the same time there is in the periphery a very much more rapid proliferation of cells, which do not, however, develop normal bone-structure. Their growth and multiplication result in the formation of an osteoid material deficient in lime-salts and much more pliable than healthy bone. The result of this pathological process in the pelvic bones is to make the pelvis yield more than it should to the mechanical forces that are brought to bear upon it.

In the rachitic pelvis the size and shape of the pelvic canal

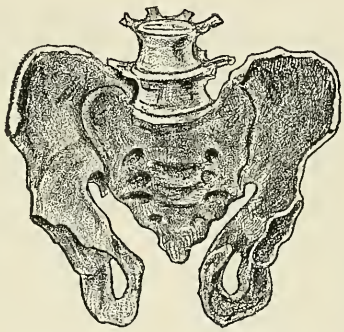


Fig. 348.—Split pelvis (Schauta).

are modified by three factors: the pressure from the trunk above and the counterpressure from the extremities below; the pull on the pelvic bones by ligaments and muscles; and an arrested development.

Characteristics.—The effect of rachitis in the pelvic bones

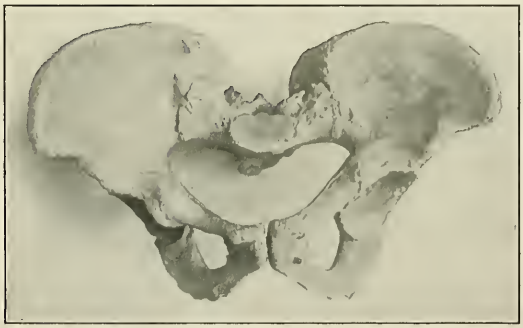


Fig. 349.—Flat rachitic pelvis: C. v., 5¼ cm.; effective trans. diam., 11 cm. (Mütter Museum, College of Physicians, Philadelphia).

upon the shape and size of the pelvic canal is not uniform. Several varieties of contracted pelvis may result. The commonest is the flat pelvis with some contraction of all the diam-

eters, but a most marked diminution in the anteroposterior diameter (Fig. 349). There may be found, in addition to this common form, a simple flat rachitic pelvis without alteration of the transverse diameters, a generally equally contracted rachitic pelvis (Fig. 350), and a so-called "pseudo-osteomalacic" pelvis, in which the effect seen in osteomalacia is produced by pressure upon the bones softened by rachitis. There are other rare forms of asymmetrical development, in connection usually with spinal disease of rachitic origin, that are described elsewhere.

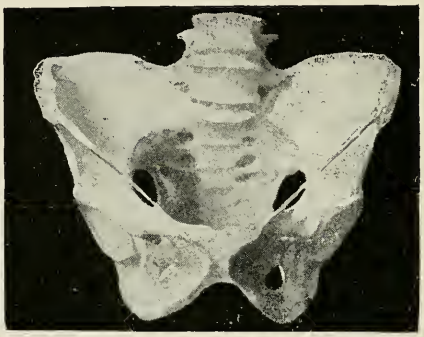


Fig. 350.—Generally equally contracted rachitic pelvis (author's collection).

Characteristics of the Flat, Generally Contracted Rachitic Pelvis.—The sacrum is pressed forward and downward between the iliac bones, and is rotated on its transverse axis, mainly by the pressure of the trunk upon it, but partly by the pull down-

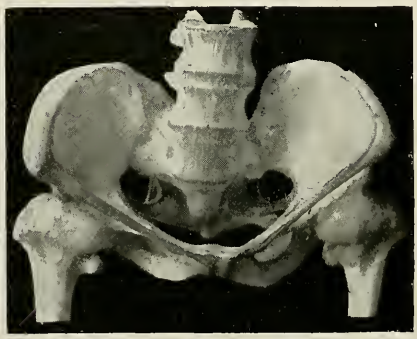


Fig. 351.—Flat rachitic pelvis, with unusual descent of the promontory, rotation of the sacrum, and lordosis (Mütter Museum, College of Physicians, Philadelphia).

ward of the psoas muscles upon the spinal column and the pull upward upon the posterior surface of the sacrum by the erectores

spinæ muscles (Fig. 349). The effect of this movement would naturally be to throw the tip of the sacrum and the coccyx directly backward, so that the posterior surface of the sacral bone would run an almost horizontal course as the woman stood upon her feet. The attachments of the sacrosciatic ligaments and muscles to the lower sacrum and coccyx, however, prevent this backward movement of the bone as a whole, and, pulling the lower portion of the bone forward, cause a sharp bend in it, usually at the junction of the fourth and fifth sacral vertebræ. The sacrum is narrowed in its transverse diameter, and the lateral concavity of the anterior surface is effaced by the forward movement of the bodies of the vertebræ between the alæ. The anterior surface of the sacrum, indeed, may be convex from side to side. By the pull of the strong sacro-iliac ligaments running from the sacrum to the posterior superior spinous processes of the iliac bones the latter are pulled downward and forward by the descent of the sacral promontory, and are consequently made to approach one another behind, but they do not keep pace with the movements of the sacrum, and consequently project more prominently than common on either side. The natural result of this movement forward and inward on the part of the posterior superior portions of the ilia would be to throw the anterior half of the innominate bones outward, but this movement is opposed by their junction at the symphysis, and to a less degree by the attachment of Poupart's ligament to their anterior superior spinous processes. The ilia, however, restrained by a somewhat yielding force, are thrown to a certain degree outward and backward, so that their upper edges run almost horizontally outward,

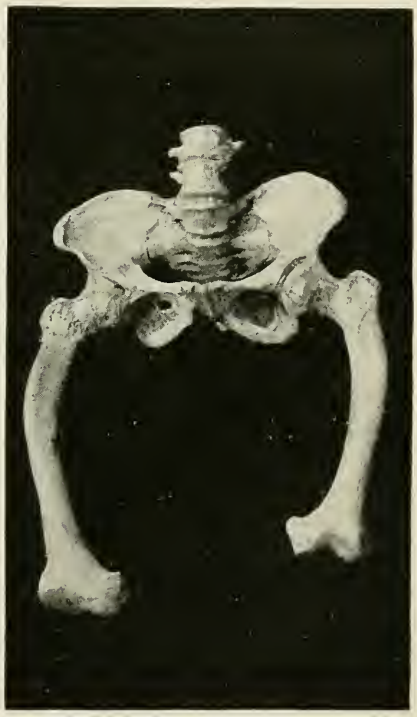


Fig. 352.—Flat rachitic pelvis with bowed femora: C. v., 5 cm.; tr., 12¼ cm. (Mütter Museum, College of Physicians, Philadelphia).

and the distance between their anterior spines becomes little less than, the same as, or even greater than, the distance between their crests. A further result of these combined forces pulling the innominate bones inward and forward behind and holding them in place in front is to produce in them an abnormal curvature, as in the case of the sacrum, or as in a bow bent between one's hand and the ground (Fig. 353). The point of angulation or greatest curvature is found on the ilio-pectineal line, back of the median transverse line of the pelvic inlet, near the sacro-iliac joints. On account of the flexion of the innominate bones the transverse diameter of the rachitic pelvis is relatively increased, but, as the whole pelvis is commonly below the normal in size, this diameter rarely exceeds, if, indeed, it equals, the normal transverse measurement. A further consequence of the exaggerated curvature of the innominate bones is to throw the acetabula forward, so that the

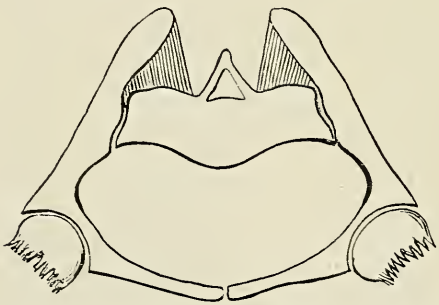


Fig. 353.—Schematic representation of the anterior position of the acetabula in a rachitic pelvis. The pressure of the femora from before backward contributes to the flattening of the pelvis (Schroeder).

counterpressure of the lower extremities is exerted more anteroposteriorly than in the normal pelvis (Fig. 353). The pubic rami and the symphysis are diminished in height and show a lessened slant outward. The cartilage at the junction of the symphysis projects inward upon the pelvic canal, standing out above the level of the bones to such a degree that it is sometimes a source of injury to the head or to the maternal structures. The force of resistance at the symphysis to the outward movement of the innominate bones sometimes bends the ends of the pubic bones inward upon the pelvic canal, giving to the pelvic inlet the shape of a figure 8. From the traction of the adductor and rotator muscles of the thigh upon the tuberosities of the ischiatic bones (increased in rachitis by the positions of the acetabula and the bowing of the femora), the latter are pulled outward and forward so that the pubic arch is greatly widened

and the transverse diameter of the pelvic outlet is increased. The anteroposterior diameter of the outlet is somewhat diminished by the excessive perpendicular curvature of the sacrum, but the contraction is relatively much less than in the conjugate of the inlet. The whole pelvis is tilted forward on its transverse axis, so that the inclination of the superior strait is increased and the external genitalia are displaced backward.

The bones of a rachitic pelvis are usually slighter and more brittle than common. They may, perhaps, show no peculiarities in structure, or in rare cases they may be found much thicker and heavier than normal.

In the generally equally contracted rachitic pelvis—a rare type—is seen mainly an arrest of development, the consequence of rachitis in very early life, which retarded growth without much affecting the shape of the pelvic inlet and canal, from the

Fig. 354.—Pseudo-osteomalacic pelvis.

fact that the pelvis had not been subjected to the pressure of the trunk during the active stage of the disease, because it ran its course to complete recovery before the child attempted to sit up or to walk. Possibly, also, the disease in some of these cases is not severe and lasts but a short time. As the deformity is the result of arrested development, a transverse contraction is found as in the fetal ill-developed pelvis.

The *diagnosis* of the rachitic origin of this type of pelvis is made by the relations of iliac spines to crests, perhaps by the history of rachitis in early infancy, and possibly by the signs of the disease in other portions of the body.

In the *pseudo-osteomalacic pelvis* (Fig. 354) the rachitis has progressed to an extreme degree and has been long continued. Efforts to walk have been made while the disease was in active

progress, and possibly the weight of the trunk has been exaggerated by attempts to carry heavy burdens. As a consequence of the pressure of the trunk and the counterpressure of the lower extremities, the pelvis bends under the forces imposed upon it. The sacrum sinks far down into the pelvic canal and is sharply curved or bent from above downward; the innominate bones are bent at a sharp angle laterally, and the acetabula are pressed inward upon the pelvic canal. When at length the bone disease has run its course, the pelvis is firmly set, by the hardening of the bones, in its unnatural position and shape. The differential diagnosis between this pelvis and the true osteomalacic pelvis is made by the direction of the iliac crests, by the firm constitution of the bones after the disease has been arrested, and by the signs of rachitis in other portions of the body. Osteomalacia, besides, has certain peculiarities of its own that enable one to recognize it without difficulty.

Fig. 355.—Pendulous belly of rachitis (Charpentier).

Diagnosis.—The diagnosis of a rachitic pelvis is made by external and internal measurements, by palpation of the exterior and interior of the pelvis, by the woman's history, and by her appearance. An individual who has had rachitis in childhood is usually of small stature, with short, thick, curved extremities; a low, broad brow; a large, square head; a flat nose; a "chicken breast," and enlarged joints. The lumbar lordosis and the rotation of the sacrum produce a sway-back, most noticeable when the woman lies on her back upon a hard surface. When she stands erect the pregnant uterus near term falls abnormally forward and downward, on account of the short abdomen and lack of engagement of the presenting part (Fig. 355). The most charac-

teristic facts in her history are that she walked first at three or four years of age and was late in getting her teeth. By the pelvimeter the normal relation between the iliac spines and crests is found disturbed. The difference in distances between the former and between the latter is much reduced. The posterior superior spinous processes are approximated, and the depression under the last spinous process of the lumbar vertebra approaches or is actually in the line drawn between them. The external antero-posterior diameter of Baudelocque is below the normal. Inter-

Fig. 356.—Appearance during life of the highest grade of rachitis; pseudo-osteomalacia (Pippingskjöld).

Fig. 357.—Skeleton of a rachitic dwarf (Medical Museum, University of Pennsylvania).

nally, the diagonal conjugate is found considerably reduced. The symphysis has less of a slant outward than it should have; the promontory is found low and prominent; the sacral bone is sharply bent upon itself, and the pelvic canal is remarkably shallow. On account of the increase in the conjugatosymphyseal angle due to the lessened slant outward of the symphysis, at least two centimeters should be subtracted from the diagonal conjugate. The difference between the two would be greater were it not for the low situation of the promontory, which compensates to a certain extent for the lessened slant of the sym-

physis, but does not entirely neutralize it. If a double promontory is found, which in these pelves is not uncommon (Fig. 361), the measurement should be taken from the promontory nearest the symphysis. Occasionally the lordosis of the lumbar vertebræ, the result of spinal rachitis, is so great as to constitute itself an obstruction above the pelvic inlet. In such a case the effective

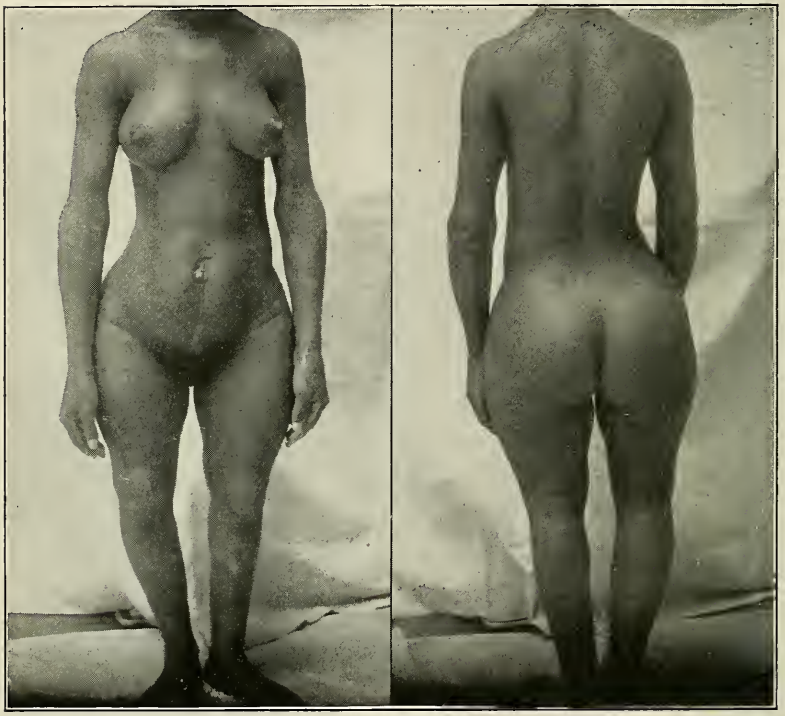


Fig. 358.—Rachitic dwarf; height, 4 feet, 1 inch. Conj. vera, 6 cm. Cesarean section (Howard Hospital).

conjugate must be taken from a point above the sacrum to the symphysis pubis.

Influence on Labor.—The influence of a flat rachitic pelvis on labor is much the same as the influence of a simple flat pelvis, except that the contraction, and consequently the obstruction to labor, is greater in the rachitic form, and that the promontory of the sacrum is more prominent and more sharply defined. The anomalies of mechanism at the inlet are the same in both varieties of pelvis, but they are exaggerated in the flat rachitic pelvis. As soon as the obstruction at the inlet is overcome, the descent

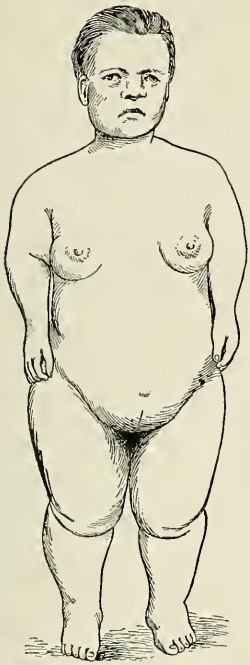


Fig. 359.—Woman with congenital rachitis (Ribemont-Dessaignes).

Fig. 360.—Flat rachitic pelvis complicated by coxalgia. Cesarean section (seen in consultation with Dr. Geo. I. McKelway).

Fig. 361.—Rachitic pelvis with double promontory: C. v., from first and from second sac. vert., 6½ cm.; tr., 12½ cm. (Mütter Museum, College of Physicians, Philadelphia).

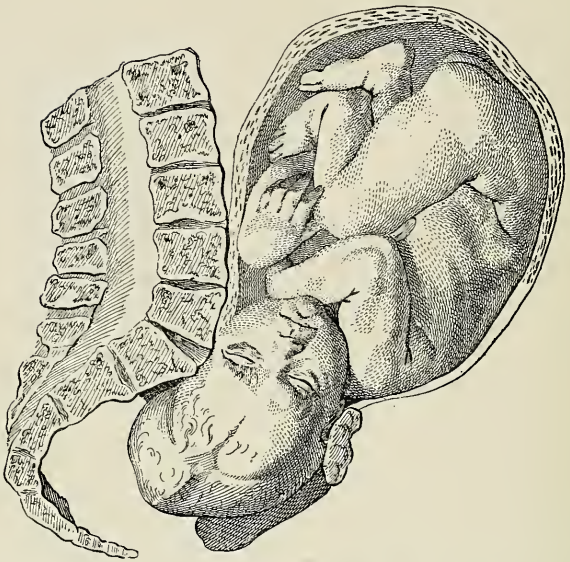


Fig. 362.—Pressure of the promontory upon the head in a contracted pelvis. (Smellie).

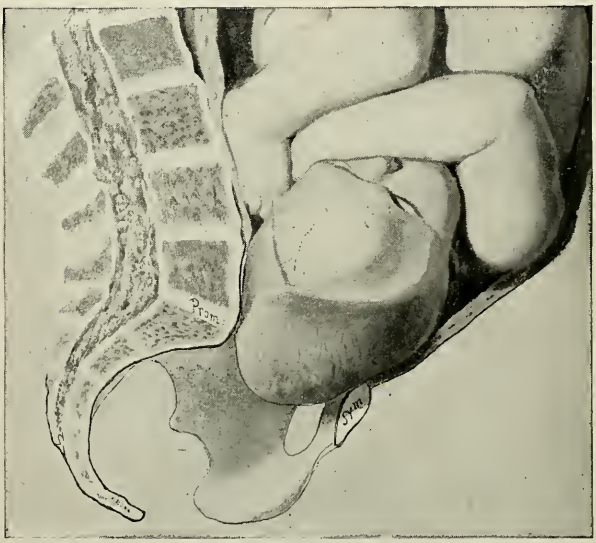


Fig. 363.—Overlapping of the cranial bones in a futile attempt of the head to engage in the superior strait of a rachitic pelvis (Smellie).

of the head and its escape are more rapid in the rachitic pelvis, because of the shallow canal and the expanded outlet. Injuries to the child's head and to the maternal tissues from pressure are

Fig. 364.—Extreme degree of osteomalacia of trunk and extremities (Kaufmann).

common. In the former, a sharp indentation may be seen on that portion of the skull pressed against the promontory in the efforts to secure engagement, the so-called "spoon-shaped" depression, with fracture of the parietal bone. Localized necroses are not infrequently seen in the maternal structures, where they have been nipped between the child's head and prominent portions of the pelvic bones—namely, in the cervical tissues over the promontory, or very rarely in the posterior vaginal vault, and in the anterior vaginal wall behind the symphysis and the ridge of the pubic bones. When the slough separates, openings may be established between the birth-canal and the peritoneal cavity, the bowel, the bladder, and a ureter.

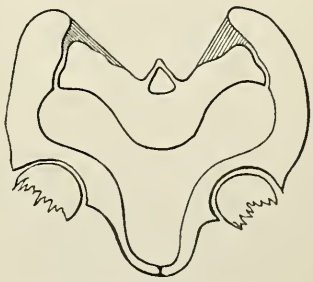


Fig. 365.—Schematic representation of an osteomalacic pelvis (Schroeder).

Osteomalacic Pelvis.—Osteomalacia, a soft condition of the

bones in consequence of an osteomyelitis and an osteitis, is exceedingly rare in America. There are certain parts of the world where it is frequently seen, notably Italy, Germany, and Austria, but in America there are but three or four examples on record. The bones of the pelvis in this disease become so soft that they yield to every force imposed upon them. They bend before the pressure of the trunk from above, the extremities from below, and the pull of the muscles attached to the pelvic bones. The flexibility of the pelvis in extreme cases of osteomalacia may be appreciated when it is stated that the superior iliac spines may be bent backward until they touch the spinal column; the horizontal rami of the pubis may be pushed inward until they almost obliterate the pelvic inlet; and the tuberosities of the ischium may be approximated until they nearly close the pelvic outlet. Not only are the pelvic walls so compressed that they almost obliterate the pelvic canal, but the spinal column also, sinking under the weight of the trunk, bends far forward and descends low into the pelvis, occupying the little remaining room in the inlet and canal, and becoming itself a serious obstruction to the engagement of the presenting part. From the lateral pressure of the thigh-bones the ischia and pubes are pushed inward and backward, making, by the former movement, a sharp beak-like projection of the pelvic inlet between the pubic rami, and by the latter much diminishing the size of the pelvic canal (Figs. 365 and 366). The sacrum is rotated on its transverse axis and is driven far down into the pelvic canal—an exaggeration of the movement seen in a rachitic pelvis. The lower portion of the sacrum and the coccyx are pulled far forward by the mus-

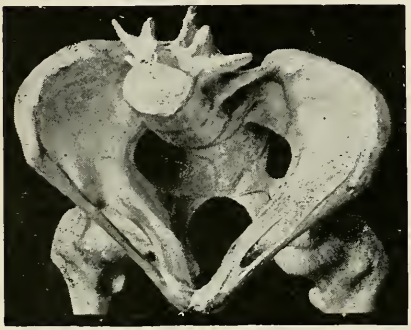


Fig. 366.—Minor grade of osteomalacic pelvis.

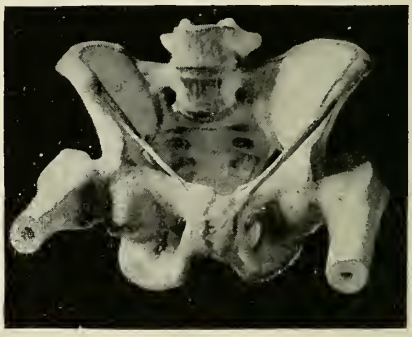


Fig. 367.—Osteomalacia, showing asymmetrical contraction at outlet.

cles attached to them, so that the sacrum is bent at a sharp angle in its lower third. The innominate bones are bent laterally at a point slightly anterior to the sacro-iliac junction, and the iliac bones may be folded upon themselves horizontally. The inclination of the pelvis as a whole is much increased.

The diagnosis may be based upon the following symptoms: The disease begins usually during pregnancy or lactation, with dull aching pains in the extremities, the back, the lumbar region, and over the anterior portion of the pelvis. Every movement increases these pains. As the disease progresses, the bones of the spinal column are so bent and compressed that the individual is diminished in stature to an extraordinary degree. She may lose as much as a foot and a half in height (Fig. 367). The gait of an osteomalacic patient is peculiar. In order to compensate for the approximation of the thighs brought about by the collapse of the pelvis, the individual must turn almost through a half-circle in order to bring one foot in front of the other. By palpation of the pelvis tenderness upon pressure is discovered over its anterior walls. The flexibility of the pelvic bones may be demonstrated by direct pressure, and an internal examination reveals, in the early stage of the disease, the peculiar beak-like space behind the symphysis, and later the almost entire obliteration of the pelvic outlet and canal by the sinking in of the pelvic walls. If it is possible to make a satisfactory internal examina-

Fig. 368.—Author's case of osteomalacia.

tion of the pelvis, the low position and the projection of the promontory at once attract attention, and the sharp angulation on the anterior face of the sacrum can be felt. On account of the exaggerated inclination of the pelvis, it may be necessary to make an examination with the patient upon her side. An osteomalacic pelvis has been taken for a kyphotic, a Robert, a pseudo-osteomalacic, a cancerous, or a fractured pelvis, but a careful, methodical examination of the patient should always lead to a correct diagnosis.

Influence Upon Labor.—The results of labor in osteomalacic pelves show that the obstruction is a serious one, although by reason of the flexibility of the pelvis in some cases the head can distend the pelvic canal sufficiently to pass through. In 85 cases collected by Litzmann, 47 ended fatally. In another series of 128 cases the labor had a spontaneous termination in 27 cases, in 4 there was premature delivery, and in 5 abortion; 4 times the labor was naturally terminated; in 8 cases version was performed, in 4 the child was extracted by the feet, in 25 forceps were employed, in 11 craniotomy was performed, and in 36 Cesarean section; rupture of the uterus occurred in 5 women before any operation was undertaken. In still another series of cases reported from Milan, the flexibility of the pelvis was so great that the child was delivered in only two instances by Cesarean section.

The most successful *treatment* is the performance of Cesarean section, and the operator should at the same time remove the ovaries, or, what is better, perform a complete Porro operation. It is beyond dispute that the cessation of sexual functions favorably modifies or actually cures the disease.

Tumors of the Pelvis.—The commonest pelvic tumors are bony excrescences, usually found over one of the pelvic joints.[1] The excrescences are originally cartilaginous projections which become ossified by an extension of bony tissue from the two bones between which they lie. These exostoses may be found over the sacro-iliac joints, over the crests of the pubis, at the iliopectineal eminences, and over the promontory of the sacrum (Figs. 370, 371, 372, 373). They may attain the size of a pigeon's egg, though they are usually not larger than a pea or nut. In the exostoses occupying the seat of the pubo-iliac junctions, directly above the acetabula, the bony growth is apt to assume a sharp, thorny shape, projecting with its point into the pelvic inlet. Kilian was the first to direct attention to this fact; he called a pelvis thus deformed "*acanthopelys*" (Fig. 374), or a "*pelvis spinosa.*" Another possible seat for a bony pro-

[1] Daniel admits only four authentic cases of osteogenic exostoses complicating labor, including one reported by the author. "Annales de Gyn.," August, 1903.

jection is along the crests of the pubic bones, the exostosis taking here the form of a long, sharp edge, and probably owing its origin to an ossification of the attachment of the iliac fascia, a transformation of tissue analogous to the ossification sometimes seen in Gimbernat's ligament. These bony outgrowths

Fig. 369.—Cystic enchondroma (Zweifel).

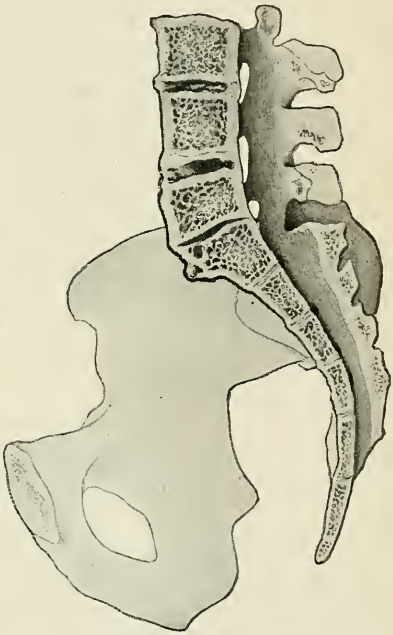


Fig. 370.—Button-like exostosis on the promontory (Schauta).

Fig. 371.—Exostosis on the symphysis (Schauta).

are a serious obstruction in labor, not so much from their encroachment upon the room of the pelvic inlet, as from the sharply localized pressure which they exercise upon the maternal structures and upon the fetal head. In the four cases

reported by Kilian, death, it was claimed, resulted in each case from a perforated uterus. Other tumors of the pelvis obstructing labor are enchondromata, fibromata, sarcomata, carcinomata, and cysts (Figs. 369, 375). These tumors are rare, and

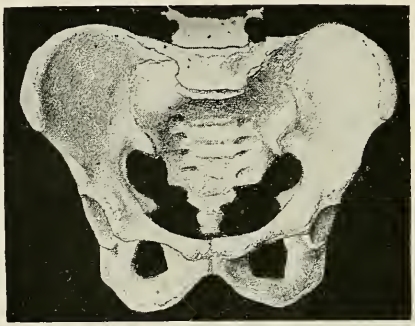


Fig. 372.—Exostoses at sacro-iliac junctions.

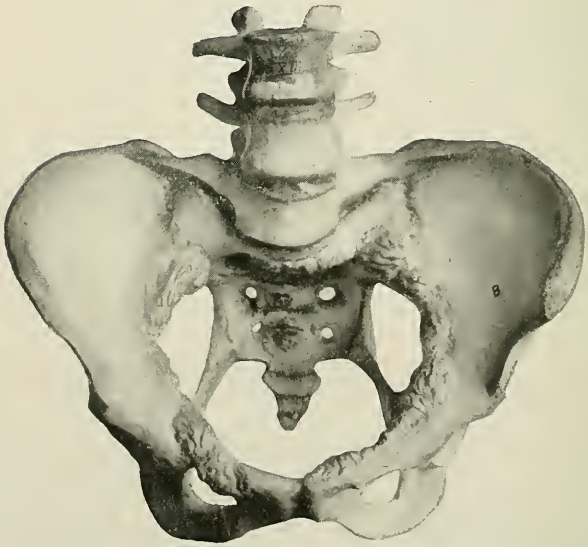


Fig. 373.—Exostoses around the pelvic brim (model in the author's collection).

their importance as obstacles in labor depends, of course, upon their size. Cysts of the pelvis are formed usually in sarcomata and in enchondromata, or are hydatid cysts. Cancer of the pelvic bones is always a secondary growth or is metastatic. It

may result in a number of small tumors in the bony pelvic walls, or may take on the form of cancerous infiltration with a consequent softening of the bones like that of osteomalacia. The treatment of labor obstructed by tumors of the pelvis is ordinarily the performance of Cesarean section. There is one case on record (Abernethy's) in which the tumor, an enchondroma, was removed by an incision in the posterior vaginal wall, but in the vast majority of cases these growths can not be reached or

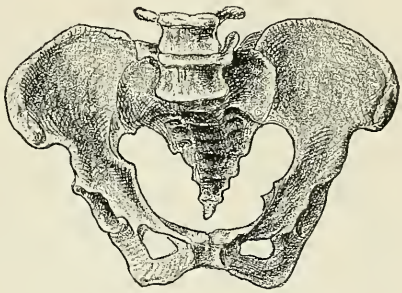


Fig. 374.—Acanthopelys.

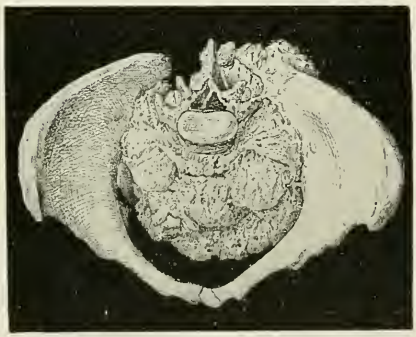


Fig. 375.—Enchondroma (Behm).

safely excised. In 49 cases of labor obstructed by a pelvic tumor, 50 per cent. of the women and 90 per cent. of the children lost their lives (Winckel).

Fractures of the Pelvis.—Out of 13,200 fractures reported from nine large hospitals in America and in Europe, but $\frac{8}{10}$ of one per cent. were fractures of the pelvis. When one considers that almost all grave injuries of the pelvis end fatally, the rarity of a pelvic deformity dependent upon a united fracture of a pelvic bone in a woman of child-bearing age may be appreciated. Most

frequently the fracture is found in the pubes, next in the ilium, next in the ischium, next in the acetabulum, and least frequently of all in the sacrum. The effect of a fracture of the pelvis upon the shape and size of its canal depends on the location of the fracture. The deformity may be due to distortion of the pelvic walls, to excessive callous formation, or to ossification of the pelvic joints nearest the seat of fracture. In a fracture of the acetabulum the result of hip-joint disease, the head of the femur may

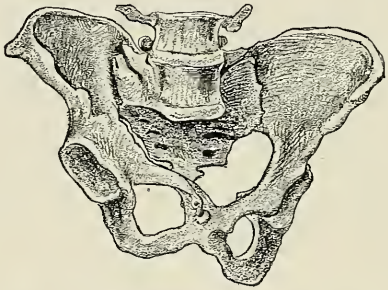


Fig. 376.—Fracture of the pelvis (Otto).

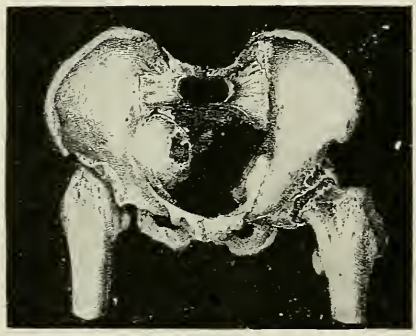


Fig. 377.—Fracture of the acetabulum in consequence of coxalgia (Otto).

project into the pelvic canal (Fig. 377). Fracture of the pubes results in an irregular distortion of the pelvic inlet, most marked, of course, on the injured side (Fig. 376). A fracture of the upper portion of the sacrum may result in a spondylolisthetic deformity (Fig. 378). Fracture of the lower portion of the sacrum is followed by a dislocation of the lower fragment inward. In a case under my observation the lower half of the sacral bone was turned in at right angles to the rest of the bone by the pull of

the pelvic muscles attached to it. A fracture of the sacral alæ may cause an oblique contraction of the pelvic inlet like that of the Naegele pelvis (Fig. 379). Neugebauer[1] reported an ex-

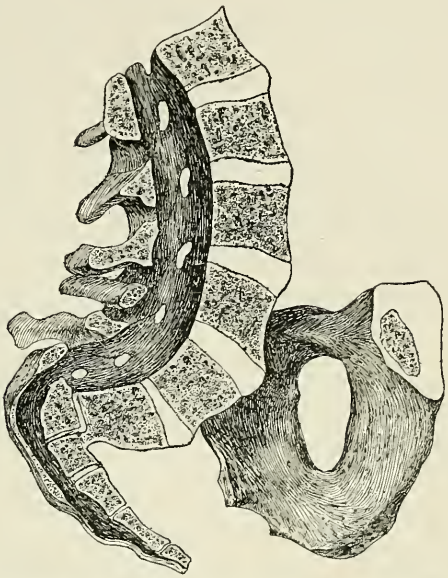


Fig. 378.—Transverse fracture of the sacrum with spondylolisthetic deformity (Neugebauer).

Fig. 379.—Fracture of the right ala of the sacrum (Fritsch).

traordinary case of bilateral fracture of the pubic rami in which there was union with callous formation on one side and an ununited

[1] "Jahresbericht über d. Fortschr. a. d. Gebiete der Geburtsh.," etc., vol. iv, p. 188.

fracture on the other, the fragments moving on each other two or three centimeters when the woman walked.

Caries and Necrosis.—The only effect of these diseases of the pelvic bones is the production, in rare cases of tuberculosis of a sacro-iliac joint, of an oblique contraction of the pelvis. When the sacro-iliac joint is affected, the ultimate result is the same as that produced by imperfect development of the sacral ala in a true Naegele pelvis. There is loss of tissue, ankylosis of the joint, and an arrest of development in the affected part if the disease occurs in early childhood.

Ankylosis and Relaxation of the Pelvic Joints.—Synostosis may develop in any of the pelvic joints; in the symphysis it occurs not infrequently, and often at an early age. A number of operators have encountered difficulty on this account in attempts to perform symphysiotomy. In otherwise unobstructed labor synostosis of the pubic symphysis is not a serious condition, although it limits the slight expansion which every normal pelvis should exhibit preparatory to and during labor.

If synostosis of the sacro-iliac joint develops in the individual's early childhood, it is followed by ill-development of the sacral alæ on the affected side, and of that portion of the innominate bone concerned in the formation of the joint, an obliquely contracted pelvis of the Naegele type being the result; but such cases are rarer than those in which lack of development in the sacral alæ is the primary occurrence. If the synostosis of the joint occurs after puberty, the effect upon the pelvis and upon the course of labor is practically *nil*. If both joints are early ankylosed, a form of laterally contracted pelvis like the Robert pelvis is the result. This kind of contracted pelvis is rarer than the transversely contracted pelvis due primarily to lack of development in the sacral alæ.

The sacrococcygeal joint becomes ankylosed, as a rule, between the thirtieth and fortieth years, but as the joint between the first and second coccygeal vertebræ is ordinarily unaffected, the pelvic outlet is capable of expansion during labor in its anteroposterior diameter nearly as well as if the sacrococcygeal joint were normal. Rarely, there is an ankylosis of all the coccygeal joints as well as of that between the sacrum and the coccyx. In these cases labor can be terminated only by a fracture of the coccyx or a rupture of a coccygeal joint, usually the first. The expulsive forces of labor may be sufficient to cause the fracture, and the bone has been heard to give way with a loud crack as the head was passing through the pelvic outlet. This accident, however, is more likely to be caused by the artificial extraction of the head.

An abnormal relaxation of the pelvic joints may be a simple exaggeration of the natural process by which the pelvic canal is made somewhat expansible preparatory to labor. It is more likely, however, to be due to some pathological condition within the pelvic joints, as an inflammatory process followed, perhaps, by suppuration, an accumulation of fluid within the joint, osteomalacia, caries, or new growths. In pregnancy the pathological relaxation of the pelvic joints may occasion some difficulty in locomotion. During labor an exaggerated relaxation of the joints predisposes to their rupture.

The Spondylolisthetic Pelvis.—The spondylolisthetic pelvis was first described in 1839 by Rokitansky, who reported two cases; Kiwisch and Kilian each followed with a description of a specimen; but we owe our knowledge of the condition mainly to the indefatigable researches of Neugebauer,[1] who collected more than one hundred cases and specimens, and to the discoveries of Lane, who has done much to clear up the etiology. The name "spondylolisthesis"[2] indicates the condition—a slipping down or dislocation of the vertebræ. To affect the pelvis the spondylolisthesis must be in the lumbosacral region (Figs. 380–382).

Characteristics.—As the name denotes, there is a dislocation of the last lumbar vertebra in front of the sacrum, the body of the former slipping down in front of the first sacral vertebra, so that its inferior border, or in advanced cases its anterior surface, comes in contact with the anterior face of the sacrum, to which it becomes united by bony union. There is, also, of necessity, an exaggerated lordosis of the lumbar vertebræ and a descent into the pelvic inlet of at least the fourth and third, and even of the second, lumbar vertebræ, which diminish by their bulk and anterior projection the anteroposterior diameter of the pelvic canal. It is only the body of the last lumbar vertebra that is displaced, and not the arch, held fast by the lower posterior articular surfaces, nor the laminæ surrounding the spinal cord; so that the latter does not necessarily suffer compression by the displacement of the vertebræ, although this result has been noted in a few cases (Fig. 381). To allow the displacement of the

[1] Franz Ludwig Neugebauer, "Bericht über die neueste Kasuistik und Litteratur der Spondylolisthesis," etc., "Zeitschrift f. Geburtshülfe und Gynäkologie," Bd. xxvii, H. 2, 1893; "Spondylolisthesis et Spondylizème," "Résumé des Recherches littéraires et personelle depuis 1880 jusqu'en 1892," Paris, G. Steinheil, 1892; "Contribution à la Pathogénie et au Diagnostique du Bassin vicié par le Glissement vertebral," "Annales de Gynécologie," Feb., 1884; "Zur Entwickelungsgeschichte des spondylolisthetischen Beckens und seiner Diagnose," Halle and Dorpat, 1882, p. 294; see also "Archiv f. Gynäkologie," Bd. xx, H. 1, und Bd. xxi, H. 2. The best article in English is by J. Whitridge Williams, "Tr. Am. Gyn. Society," vol. xxiv, 1899, with full bibliography to date.

[2] σπόνδυλος, vertebra, and ὀλισθησις, a slipping out or down.

body of the last lumbar vertebra the interarticular segment of the spinal arch and the pedicles are enormously lengthened from behind forward and are bent at an angle downward (Fig. 381). After a time this segment may exhibit a transverse fracture or a solution of continuity from pressure and attrition. The deformity is always gradual in development. If it begin during the child-bearing period, successive labors become increasingly difficult. As the vertebra descends, it pushes the sacrum backward

Fig. 380.—Spondylolisthesis, well marked (Schauta).

Fig. 381.—Spondylolisthesis, beginning (Schauta).

Fig. 382.— Last lumbar vertebra of spondylolisthesis (*a*), contrasted with a normal fifth lumbar vertebra (Neugebauer).

and downward, and with it depresses the posterior portion of the pelvic brim. To compensate for this movement the anterior half of the pelvic brim rises and the height of the symphysis is increased. This movement of the pelvis diminishes very markedly its inclination, and disturbs the normal relationship between the bones and the soft structures that overlie them. The base of the triangle formed by the pubic hair in women is well below the upper edge of the symphysis, and the external genitalia are pulled so far forward that the vulvar orifice is

directed anteriorly as the patient sits or stands. There are, moreover, the same displacements of the pelvic bones that are seen in kyphosis—a rotation backward of the sacrum on its transverse axis; a rotation outward of the upper portions, and inward of the lower portions, of the innominate bones on their antero-posterior axes. The descent of the lumbar vertebræ drags the large arteries of the lower trunk into the pelvic inlet, so that the iliac vessels and the bifurcation of the aorta may be felt in a vaginal examination. The degree of contraction in the conjugate diameter of the inlet depends upon the descent of the last lumbar vertebra and the degree of the lordosis. The contraction is usually not excessive, but it may be so great as to preclude the possibility of the engagement of the fetal head.

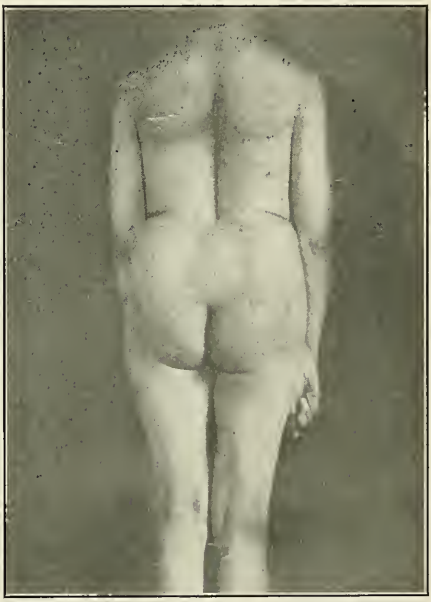


Fig. 383.—Author's case of spondylolisthesis.

Etiology.—The etiology of spondylolisthesis at the lumbo-sacral junction is still obscure. It has been attributed to direct injuries of, and to faults of development or ossification in, the interarticular segments of the spinal arch. It is certain that these are predisposing causes, but the observations of Lane appear to demonstrate that the commonest cause of the deformity is an exaggerated pressure from the trunk above exerted often upon healthy bone. As a result of this pressure a joint is formed in the intervertebral disc, and the interarticular segments of the last lumbar vertebra undergo stretching, pressure, angulation, and atrophy until the bone is actually severed. Following or accompanying these changes in the arch, the body of the last lumbar vertebra is gradually displaced downward and forward. Spondylolisthesis has followed an injury, presumably a fracture, of the lumbar vertebræ.

Frequency.—Neugebauer collected 115 cases, to which number Williams added 8. The author has seen one case in a single woman, aged 59 (Fig. 383). Of the 124 cases, 8 were in men.

Diagnosis.—The diagnosis of a spondylolisthetic pelvis is not

easy; it can be made only by close attention to the patient's history, by a careful observation of her appearance, by an internal and external examination of the pelvis, and by pelvimetry. In the history of the case it may appear that the individual was the subject of a serious accident, such as a fall from a height or a fracture of the pelvis by the passage over it of a heavy weight, or it may be learned that she has carried excessively heavy burdens for a long time. The woman's height is diminished and the length of the abdomen is shortened. Viewing the patient from behind, there appears what is called the saddle-shape or "sway" back, the lumbar vertebræ projecting visibly far forward and being displaced downward, throwing into bold relief the

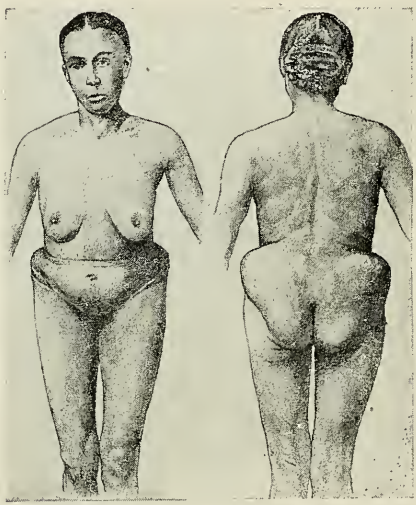


Fig. 384.—Breisky's case of spondylolisthesis.

posterior superior spinous processes and the rims of the iliac bones, and producing quite a deep furrow along the course of the spinous processes of the lumbar vertebræ. The apposed articular processes of the first sacral and the last lumbar vertebræ stand out as button-shaped prominences on the inner surface of the posterior rims of the ilia. The buttocks are flat and are pointed below, giving to the region a cordiform appearance. In front there is a pendulous belly; a deep crease is observed running across the lower abdomen a short distance above the symphysis. Laterally, the floating ribs are seen almost to rest upon the crests of the ilia or actually to sink between them, and the soft structures of the flanks are thrown outward in prominent

folds. The trunk is shortened, and the limbs appear relatively too long (Fig. 384). The patient's body being thrown forward by the deformity of the spine, an effort to maintain an equilibrium is made by carrying the shoulders far back; as the individual walks, a disposition to fall forward may be noted, and she states, perhaps, that she is unable to carry any load upon her arms in front of her body, for fear of toppling over upon her face. She may also complain of pain or of a grating sensation and sound in the small of the back (crepitus). The gait is peculiar; the toes are not turned out, and the feet are swung around each

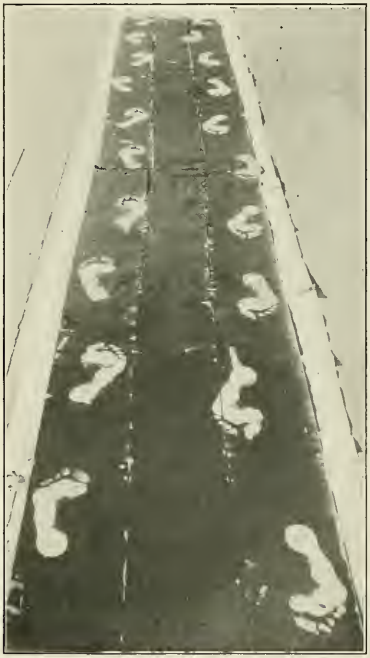


Fig. 385.—Footprints of author's case of spondylolisthesis.

other so that the footprints fall in a straight line (Fig. 385). Upon an internal examination of the pelvis,—best conducted, according to Neugebauer, in an upright or lateral position,—the lordosis of the lumbar vertebræ is at once discovered. The angle formed by the attachment of the last lumbar vertebra to the sacrum may be detected with ease, especially in a rectal examination, and it should be noted that the body of this vertebra does not possess lateral projections, transverse processes, or alæ. By their absence the bone is distinguished from a projecting

promontory. Pulsating iliac arteries may be felt, and it is possible even to reach the bifurcation of the aorta,—as first pointed out by Olshausen,—but this symptom is not pathognomonic. It is possible to reach the bifurcation of the aorta in a vaginal examination in the extreme lordosis of some rachitic pelves and of the osteomalacic pelvis, in lumbrosacral kyphosis, and in some cases of dorsolumbar kyphosis.

The external palpation of the pelvis demonstrates the absence of inclination. A measurement of the pelvis may show a diminution in the external conjugate diameter, an increased height in the symphysis pubis, an increased distance between the posterior superior iliac spines, and a diminished distance between the anterior iliac spines and the crests. The external conjugate may not be decreased at all; it may even be increased if measured from the top of the sacrum, which is pushed backward. There is some diminution in the diameters of the outlet. The internal conjugate diameter must be measured from the lumbar vertebra nearest the symphysis pubis, usually the fourth. This is called the "false" or "effective" conjugate diameter of the spondylolisthetic pelvis. On account of the decreased inclination of the pelvis it is not necessary to subtract more than the ordinary sum from the diagonal conjugate. In fact, the diagonal conjugate may approach very nearly the length of the true, or may actually measure less.

Influence Upon Labor.—The influence of a spondylolisthetic pelvis upon labor is that of a flat pelvis. The obstruction in the former may be overcome more easily on account of the bow-like shape of the projecting vertebra and the coincidence of the uterine and pelvic axes. The obstruction to labor depends entirely upon the projection of the lumbar vertebræ. This projection may be so slight as scarcely to influence the progress at all, or it may be so great as to make delivery by the natural channel quite impossible. There is noticed in labor something of the same mechanism that is seen in the flat pelvis for the purpose of overcoming the obstruction—namely, decreased flexion, transverse position, and exaggerated lateral inclination of the head. On account of the forward dislocation of the external genitalia and of the pelvic floor, lacerations of the latter are the rule, and the tears are often complete into the rectum. This liability to injury is explained by the fact that the presenting part impinges directly upon the middle of the pelvic floor as it descends the birth-canal, instead of being directed forward to the vulvar orifice. Fistulæ of the anterior vaginal wall are likewise common, from the localized pressure to which this region is subjected while the head is passing the obstruction at the inlet.

The presenting part is thrown forward by the projecting vertebræ, and is received upon the prominent ridge of the pubic bone, greater in height and higher in situation than in the normal pelvis.

Treatment of Labor Obstructed by Spondylolisthetic Pelvis.—The management of labor in these cases is governed by the same principles that obtain in the management of labor in a flat pelvis. If the effective conjugate is over 9.5 cm., the woman can be delivered spontaneously, by forceps, or by version. With an effective conjugate of 7 to 9.5 cm., the induction of premature labor and the performance of symphyseotomy [1] might be considered; or craniotomy should be done if the child is dead. If the effective conjugate is at or under 7 cm., delivery must be effected by a Cesarean section. These rules presuppose, of course, a child of average size.

Fig. 386.—Angulation of the spine in kyphosis.

After the woman's convalescence from her delivery she should be referred to an orthopedic surgeon for the adjustment of a brace which makes her more comfortable and might retard the progress of her disease.

Kyphosis.—The kyphotic pelvis was first adequately described in 1865 by Breisky, although its peculiarities had been recognized by Litzmann in 1861 and by Neugebauer in 1863. The condition was called by Herrgott "spondylizema," a name adopted by Neugebauer and others (Figs. 387, 388).

[1] Symphyseotomy has been performed twice for spondylolisthesis by Morisani and Williams. Both operations were fatal. The effective conjugate is apt to be less than it seems, so that in case of doubt as to the measurement Cesarean section should be performed.

Characteristics.—The degree of deformity in a kyphotic pelvis depends upon the situation of the hump: the nearer this is to the sacrum, as a rule, the greater is the deformity in the pelvis. Lumbosacral kyphosis is almost as frequent as the lumbar and dorsolumbar combined. There is a compensating lordosis of the lumbar spine, but not enough to keep the center of gravity of the trunk from being too far forward. In conse-

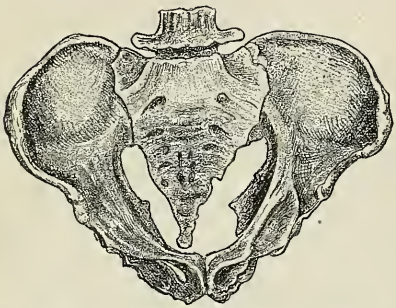


Fig. 387.—Kyphotic pelvis from above (Barbour).

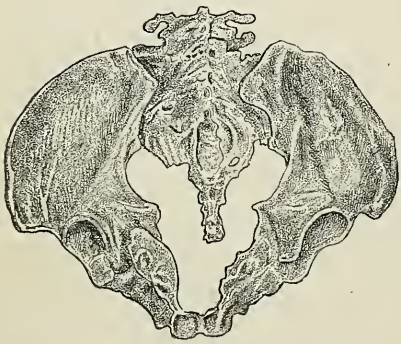


Fig. 388.—Contracted outlet of a kyphotic pelvis (Barbour).

Fig. 389.—Kyphosis: greatest transverse diameter at outlet, 7 cm. (Mütter Museum, College of Physicians, Philadelphia).

quence, the weight of the trunk is transmitted in a direction from before backward, so that the sacrum is rotated on its transverse axis in a direction the reverse of that seen in rachitis—namely, backward and scarcely at all downward. The result of this movement is to make the sacrum straighter, narrower, more curved from side to side, and longer (Fig. 387); to pull the posterior superior spinous processes of the iliac bones closer to-

2

1

3

4

5

6

1, Lumbodorsal kyphoscoliosis (Schauta); 2, lordosis from paralysis of spinal muscles (author's case); 3, skeleton of a girl with coxalgia (Medical Museum, University of Penna.); 4, rear view, 5, side view, of obliquely contracted pelvis, the result of tuberculous disease in one knee-joint (author's case); 6, scoliosis from unilateral atrophy of spinal muscles (author's case).

gether, and to separate the anterior spines more widely. The diminished width between the posterior superior spinous processes is caused partly by the pull of the sacro-iliac ligaments. The sacrum can not move in any direction without dragging the ilium on each side by these ligaments, thus approximating their upper posterior surfaces. The diminution of the interspinous

Fig. 390.—Lumbosacral kyphosis, front and profile views (author's case).

measurement posteriorly depends also upon the narrowness of the sacrum. To compensate for the movement of the upper portion of the sacrum backward, the lower portion of the bone projects forward, into the pelvic outlet. To preserve the body from falling forward, the legs are slightly flexed and the pelvic inclination is almost entirely lost. This posture puts

the iliofemoral ligaments on a stretch, which pull outward the upper portions of the innominate bones. To compensate for the movement outward of the iliac bones the lower segments of the innominate bones move inward upon the pelvic outlet; in other words, there is a rotation of the innominate bones upon their anteroposterior axes. The result of these movements in the pelvic bones is to enlarge the pelvic inlet in its anteroposterior diameter, and to contract the canal toward the outlet, where the diminution of the diameters is most marked in the transverse (Fig. 388).

Fig. 391.—Lumbosacral kyphosis (rear).

In the cases of lumbosacral kyphosis the upper portion of the sacral bone may be involved in the necrotic process and the sacrum may exhibit deformities by destruction of its tissues (Fig. 394) The other characteristic deformities of the kyphotic pelvis are most marked in this type, unless, as in one instance, the body is bent almost double, and it is necessary to rest the anterior portion upon an artificial support, as a cane. In this case the pelvis, although relieved of the weight of the trunk, is obstructed by the overhanging lumbar vertebræ to such a degree, perhaps, that the inlet is practically obliterated (pelvis obtecta). In all cases of exaggerated lumbosacral kyphosis the projecting lumbar spine blocks the pelvic inlet and seriously obstructs labor. The conjugate diameter must be measured to the lumbar or even to the dorsal vertebræ, and is exceedingly short. In 21 labors complicated by this deformity of the pelvis, 66 per cent. of the mothers and 75 per cent. of the children were lost (Winckel).

Influence on Labor.—The influence of the kyphotic pelvis upon labor is usually not felt until the presenting part has descended to the pelvic floor. In consequence of the shortened perpendicular diameter of the abdominal cavity there is always a tendency to a transverse position of the fetus *in utero*, but this position is ordinarily corrected by the first few labor-pains. The head presents in 95 per cent. of cases, the breech in 2 per cent., according to the statistics collected by Klein,[1] embracing 172

[1] "Archiv f. Gyn.," Bd. 1, H. 1.

births in 95 women. When the head arrives at the pelvic floor, if the occiput is directed backward, as it is in a third of the cases, anterior rotation will very likely be prevented and there will be a

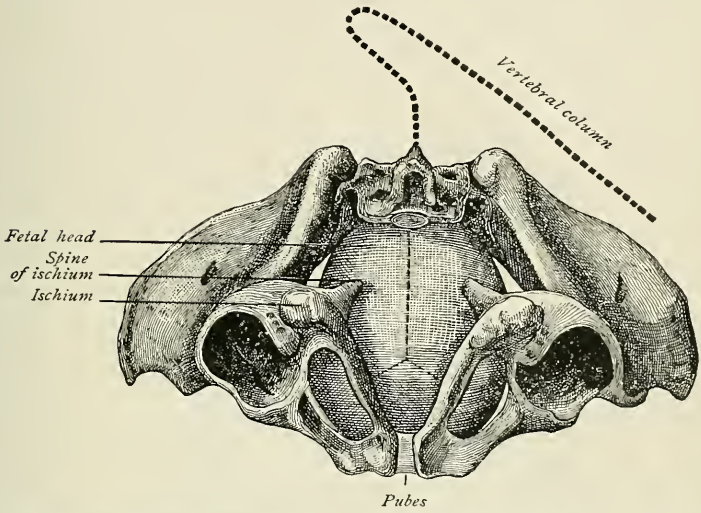


Fig. 392.—Head arrested by spines of ischia in a kyphotic pelvis (Budin).

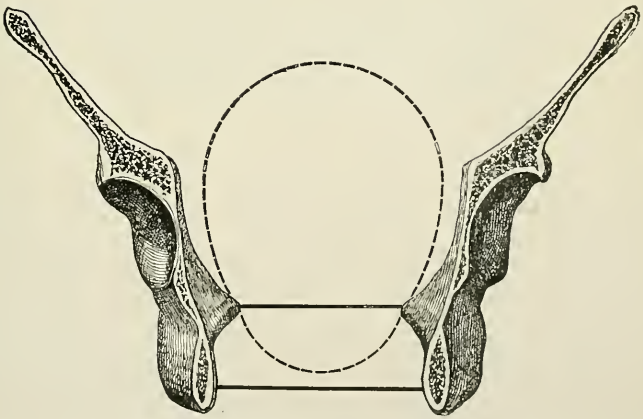


Fig. 393.—Vertical section of kyphotic pelvis, showing the head arrested by the spines of the ischia (Budin).

persistent posterior position. A posterior rotation of the occiput originally directed anteriorly is not rare. It occurred in five of Klein's cases and in one of the author's. If the occiput is

directed anteriorly, the transverse diameter of the head may be caught between the approximated spines or tuberosities of the ischiatic bones, and labor be brought to an indefinite standstill (Figs. 392, 393). The head usually enters the pelvis obliquely or transversely. Rotation only occurs as the head emerges from the outlet. Face presentations occur in a large proportion of cases —four per cent. of the head presentations.

Management of Labor in Kyphotic Pelves.—An exact measurement of the pelvis is essential to a determination of the proper means of delivery. If the child is of normal size, pregnancy may be allowed to go to term in pelves measuring 8.5 cm. and more in the transverse diameter of the pelvic outlet. Any asymmetry of the ischia constitutes a serious complication, necessitating operative interference that might be avoided in a symmetrical pelvis with smaller diameters. Below 8.5 cm. down

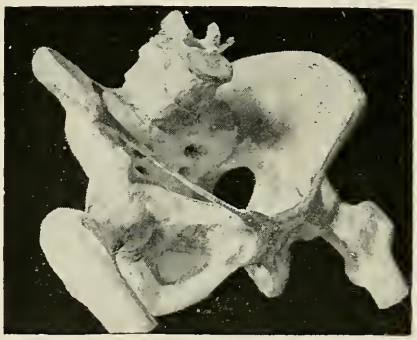


Fig. 394.—Lumbosacral kyphosis (pelvis obtecta).

to 6 cm. in the transverse measurement of the outlet, labor should be induced at the thirty-sixth week. With a measurement less than 6 cm. Cesarean section is indicated absolutely. If the woman is first seen in labor at term, the head, if it is presenting, should be allowed to descend to the pelvic floor and the woman should be encouraged to make vigorous expulsive efforts. If the occiput shows a disposition to rotate posteriorly, the movement should not be interfered with, for the greater bulk of the occipital region finds more room posterior to the tuberosities than it does anteriorly. The author has seen an occipito-anterior position of the vertex, in a kyphotic pelvis, remain stationary until the head rotated from an anterior to a posterior position, when the vertex was expelled without further difficulty. With a transverse diameter of 8.5 cm. spontaneous

delivery may be possible, though it may be necessary to use forceps. Below 8.5 cm. the forceps may be tried cautiously, but pubiotomy is likely to be required. In no other form of contracted pelvis is this operation so successful. Klein found, by experiments on the cadaver, that by a separation of the symphysis to 6 cm. in a kyphotic pelvis, the tuberosities moved 4.5 cm. further apart. Pubiotomy, therefore, might be expected to be successful in a transverse diameter of 6 cm. or even a trifle less. If the child is dead or if the graver obstetrical operations are not admissible, craniotomy should be performed, in case the forceps fail. In employing forceps the operator must remember the dangers of rupture of the symphysis and deep tears of the vaginal walls to which kyphotic subjects are particularly liable. Version has given the worst results of all the obstetrical operations in kyphotic pelves. It is, therefore, as a rule, contraindicated, although in one of the author's cases, complicated by eclampsia, it proved the

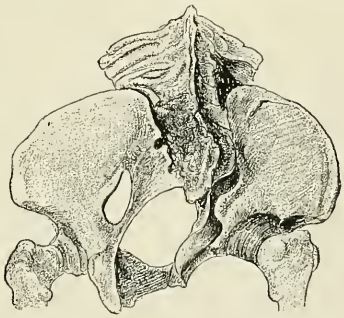


Fig. 395.—Asymmetrical contraction of the outlet from kyphoscoliosis.

best way to extract the child. Klein's statistics show that in fifty-eight to sixty per cent. of cases the labor must be terminated by operative interference.

Diagnosis.—The diagnosis of a kyphotic pelvis presents no difficulties. The hump-back is obvious, and the history is easily obtained that the spinal deformity developed early in life. The pelvic measurements diagnostic of this deformity show an increased separation of the iliac crests and the anterior spines, an abnormally long conjugate diameter of the inlet, a diminished distance between the posterior superior spines, an approximation of the tuberosities of the ischiatic bones, and some diminution in the anteroposterior diameter of the pelvic outlet. The buttocks are flat and pointed below, the external genitalia are displaced forward and upward, and the upper edge of the symphysis is above the upper edge of the pubic hair. Care should always be exercised to detect asymmetry in these pelves, to discover an

arrested development with general contraction which is common, and to diagnosticate lateral contraction at the pelvic inlet. These complicating deformities constitute often insuperable obstacles in labor, even though the transverse diameter of the outlet is not excessively contracted.

Klein gives the following table, showing the contrast between kyphotic, normal, and rachitic pelves, taking a typical example of each, the measurements being made upon the dried specimen:

	Normal Pelvis	Lumbodorsal Kyphosis	Lumbar Kyphosis	Lumbosacral Kyphosis	Flat Rachitic Pelvis
Sp. il. ant. sup.,	22.3	28.1	25	21.7	27.25
Cr. il.,	26.8	28.7	27.3	25.2	27.75
Conj. extern.,	16.3	18	18.5	15.5	14.5
Spin. il. post. sup.,	7.7	5.7	6.4	3.5	
Height of anterior surface of sacrum,	10.4	14.2	8.2	8	
Height of posterior surface of sacrum,	9.3	9.4	7.2	6.2	
Diagonal conjugate,	12.5	19.3	13.6	14.5	8.7
True conjugate,	10.9	17.7	13.2	13.6	7.6
Transverse diameter of pelvic inlet,	12.9	14.5	11.8	11.2	14.2
Spines of the ischia,	10.2	9.5	6.6	5.9	13.5
Tuberosities of the ischia,	11.4	10.1	4.6	4.5	13.2

Prognosis.—The outlook for the mother and child depends upon the degree of the deformity and upon the management of the labor. In the minor grades of contraction in the cases collected by Klein, the maternal mortality was 6.6 per cent. In the graver cases it was 16 per cent. Neugebauer puts the maternal mortality at 24.3 per cent. The mortality of the infants has varied in the different statistical tables from 36 to 49 per cent.

Frequency.—The kyphotic pelvis is said to be somewhat infrequent, but the practitioner in active practice will surely encounter several examples in the course of his career. The writer has had under his care eight well-marked cases of kyphotic pelvis, in two of which Cesarean section was necessary. In three delivery was spontaneous. One required forceps, another, version. Klein found, in 42,113 labors, only 7 women with kyphosis—a proportion of 1 : 6016.

Scoliosis.—In the scoliotic pelvis there is some degree of oblique contraction. The innominate bone, toward which the lumbar vertebræ are bent, receiving the greater part of the weight of the trunk, is pushed upward, inward, and backward by the

extra pressure exerted upon it by the head of the femur. The acetabulum on this side is displaced anteriorly and upward; the symphysis is pushed over to the opposite side. The degree of asymmetry is rarely sufficient to constitute an obstruction in labor. The scoliotic pelvis is, however, most often rachitic, and in addition to the asymmetry of scoliosis there may be the contraction of a rachitic pelvis (Figs. 396, 397).

Kyphoscoliosis.—In a combination of kyphosis and scoliosis of the spinal column the pelvis shows, perhaps, the combined

Fig. 396.—Scoliosis. Rachitic pelvis: C. v., 8.25 cm. Craniotomy on a dead child (author's case).

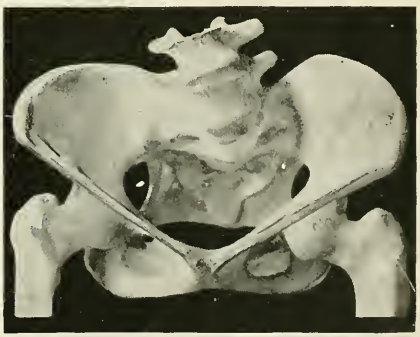


Fig. 397.—Scoliotic rachitic pelvis.

features of both, but the kyphosis, being of rachitic, not of carious, origin, is not angular, and is situated high in the dorsal region, where it may be compensated for entirely by lumbar lordosis (Figs. 398, 399). The kyphoscoliotic pelvis is usually an asymmetrically contracted rachitic pelvis (Pl. 11, Fig. 1).

Lordosis.—Primary lordosis not the result of pelvic deformity or of spinal disease is very rare. Aside from some illustrations of it in an article by Neugebauer (*loc. cit.*), the writer knows of no reference to the subject except his own (Pl. 11,

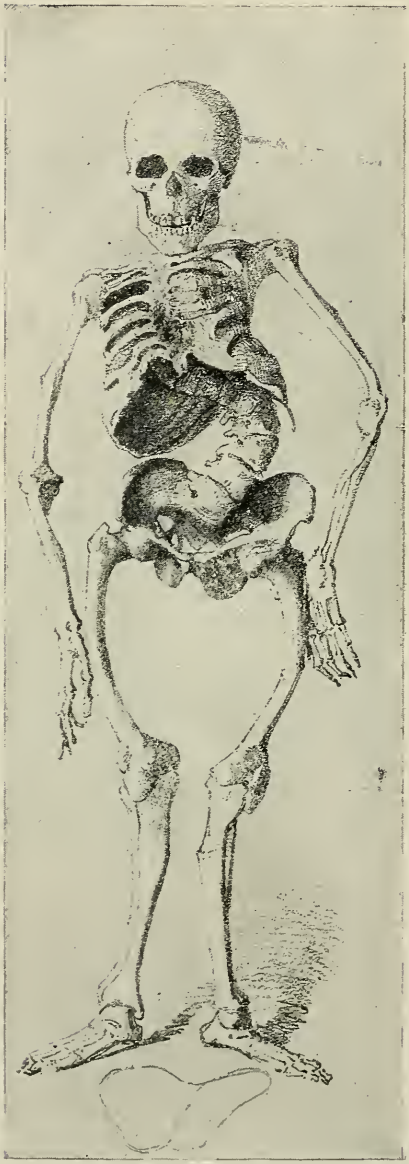


Fig. 398.—Kyphoscoliosis (Leopold).

Fig. 2).[1] It may readily be seen what an influence this deformity would have upon coition and parturition, and how it might be an insuperable obstacle to the natural completion of the latter.

Fig. 399.—Kyphoscoliosis. Pelvis of rachitic type: C. v., 8.50 cm. (seen in consultation with Dr. Geo. I. McKelway).

Anomalies Due to Diseases of the Subjacent Skeleton.—Coxalgia.—The deformity of the pelvis due to coxalgia in early childhood is of two types. In one there is an oblique contraction by a displacement of the innominate bone on the healthy side up-

[1] Hirst, "The Influence of the Habitual Inclination of the Pelvis in the Erect Posture upon the Shape and Size of the Pelvic Canal," "University Med. Magazine."

ward, backward, and inward, on account of the pressure of the femur, the weight of the body being received mainly upon the sound leg. This form of coxalgic pelvis, as a rule, presents no serious obstacle to delivery unless it is associated with a rachitic deformity (Fig. 400). Special attention, however, should always be paid to the length of the conjugate diameter of the inlet, and to the transverse diameter of the outlet. In the other variety of coxalgic pelvis the deformity is also an oblique contraction, but it is the bone on the diseased side which is driven inward upon the pelvic canal. This displacement of the innominate bone is the result of an arrested development on the corresponding side of the pelvis, and is usually associated with an atrophy of the sacral ala and an ankylosis of the sacro-iliac joint. The contraction of the pelvic canal is much more serious in this

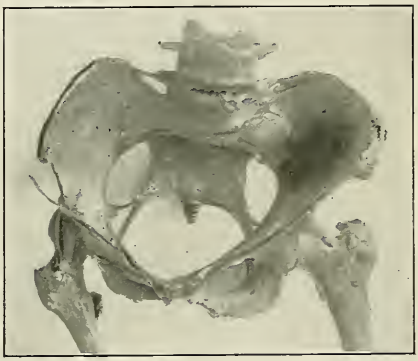


Fig. 400.—Coxalgic pelvis (Mütter Museum, College of Physicians, Philadelphia).

form, and there may be all the difficulties in labor encountered in the true Naegele pelvis.

The ankylosis of the hip-joint and the fixation of the thigh in coxalgia may be a source of serious embarrassment in labor, especially in the application of forceps and the extraction of the fetal head through the pelvic outlet.

Luxation of the Femora.—Dislocation of the thigh-bones, if congenital or occurring early in childhood and not corrected, has some effect upon the size and shape of the pelvis, but usually not enough seriously to obstruct labor. If one thigh is dislocated, the weight of the body may be thrown mainly upon the other leg, and this may produce an oblique contraction of the pelvis of the kind already described. If the thigh-bone is displaced forward, the anterior half of the pelvis may be driven in a little upon the pelvic canal, and the head of the thigh-bone, as in one case reported, may project over the horizontal

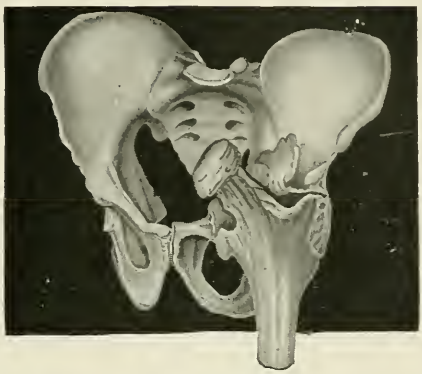


Fig. 401.—Anterior dislocation of femur.

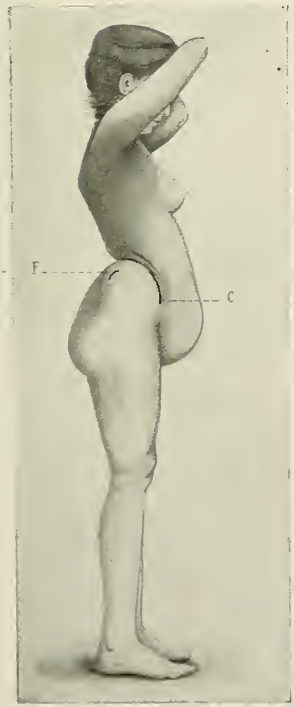


Fig. 402.—Congential luxation of both femora: C, Crest of ilium; F, trochanter of femur (Henry).

Fig. 403.—Congenital dislocation of femora, rear view, showing wide separation of the thighs with the feet together (author's case).

ramus of the pubis into the pelvic inlet (Fig. 401). In the congenital luxation of both femora backward upon the iliac bones there is an excessive rotation forward of the sacrum, an increased width of the pelvic canal, and from the drag of the attached muscles and ligaments between the thighs and the pelvis the ischiatic tuberosities are pulled outward, upward, and backward, so that the pelvic canal is made shallow and its outlet very wide. The heads of the femora move up and down on the ilia when the patient walks, and the distance between the lower edge of the symphysis and the inner condyles of the femora is shortened.

There is a peculiar waddling gait, a marked lordosis, and the shoulders are carried far back. The rear view of the patient shows an unusually wide separation of the thighs as the individual stands erect with the heels together.

In the absence of one lower extremity the pelvis may be contracted obliquely to a serious degree, as in La Chapelle's case,[1] by the pressure on one side of the remaining leg. Any condition which throws the weight of the body mainly on one leg

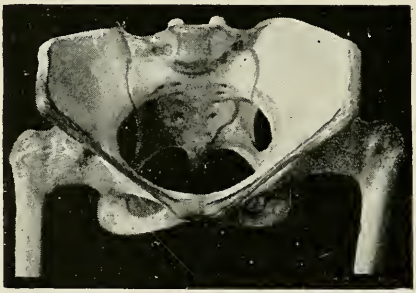


Fig. 404.—Congenital luxation of both femora.

may produce the same effect, as is shown in a case of the author's (Pl. 11, Figs. 4, 5), in which there was tuberculous disease of a knee-joint early in infancy, followed by marked shortening and atrophy of the leg. The weight of the body falling mainly on the sound leg, the corresponding innominate bone is pushed upward, backward, and inward, diminishing the area of intrapelvic space on its own side. Torggler reports an interesting case of this kind in which the disability of one leg was due to scleroderma.[2] In the absence of both lower extremities there is the characteristic "sitz-pelvis," in which the innominate bones are usually rotated on an anteroposterior axis,

[1] "Pratique des Accouchements," iii, p. 413; according to Schauta, the only case on record.

[2] "Centralbl. f. Gyn.," 1889, p. 612.

so that the crests of the ilia are approximated and the tuberosities of the ischia are separated. Minor deformities of little practical importance may be the result of unilateral or bilateral club-foot or of the bowing of one or both lower extremities. In the former there is an increased inclination of the pelvis, an approximation of the acetabula and of the ischiatic tuberosities, and a narrow pubic arch (Fig. 405).

Fig. 405.—Pelvic deformity, the result of double club-foot (Meyer).

The Management of Labor Obstructed by the Commonest Forms of Contracted Pelvis: a Simple Flat, a Rachitic Flat, and a Generally Contracted Pelvis.—There is nothing in medicine requiring more experience and good judgment than the management of labor obstructed by a contracted pelvis. It is extremely difficult to formulate hard-and-fast rules for the guidance of the inexperienced when so many factors must be taken into account. The rules given below govern the writer's practice in the average case, but due attention must be paid to the history of past labors, the size of the child, its development, and the compressibility of its head, the age of the woman, the build of both parents, and the probable strength of the expulsive forces, greatest in the primipara and less with successive labors.

If the diagnosis of a conjugate diameter of 9.5 cm. or less is made during pregnancy, the physician must choose induction of premature labor, forceps, version, pubiotomy, or Cesarean section at term. If the conjugate diameter measures as low as 9.5 cm., it is a safe plan to induce labor two to four weeks before the expected termination of pregnancy. This course entails no great additional risk upon the child if its parents are in a position to afford it the best care and nursing, and it is much the safest plan for the mother, the induction of labor, done prop-

erly, having no maternal mortality.[1] It is true that many women with a conjugate of 9.5 cm. can deliver themselves without difficulty at term. Spontaneous delivery with a measurement as low as eight centimeters and under has been recorded. But the majority of women with a conjugate of 9.5 cm. will experience abnormal delay and difficulty in labor, with added risk to themselves and to their children; and in a certain proportion of cases a conjugate of 9.5 cm. proves an insuperable obstruction in labor, and is the cause of ruptured uterus or death from exhaustion in the mother or of injury to the child's brain. These results are to be feared especially if the child is overgrown or if the mother's expulsive powers are weak—two conditions impossible to predict with absolute certainty. For these reasons, then, the rule to induce premature labor when the conjugate is at or below 9.5 cm. is a safe one. If the conjugate measures eight centimeters or more, the most successful treatment is still the induction of premature labor at the thirty-sixth week. By this plan the majority of women with a conjugate of eight centimeters or a trifle less are delivered spontaneously or with no more serious operation than the application of forceps. If the conjugate measures seven centimeters or less, the induction of premature labor four weeks before term cannot be expected of itself to secure a spontaneous delivery. Cesarean section gives a better result for both mother and child. In such cases, therefore, the physician may wait until term or shortly before it, so that his operation shall secure the birth of a child vigorous in development. With a conjugate diameter of the superior strait at and below 7 cm., the woman should be allowed to go to term and should usually be delivered by Cesarean section.

If the physician sees the patient for the first time in labor, or only discovers the deformity after labor has begun, he must choose one of the following modes of delivery: A waiting policy, to allow the engagement of the head by natural forces; the application of forceps; the performance of version, pubiotomy, or Cesarean section. While the child is alive, craniotomy should not be considered. The selection of the best mode of delivery in contracted pelves is one of the most difficult problems in obstetrics. If the patient is primapara and the conjugate is above nine centimeters, natural forces, in the majority of cases, if the fetus is not overgrown, will secure the engagement of the

[1] This statement is based upon the writer's experience in private practice, and not upon hospital statistics. It does not hold good for labors induced before the thirty-sixth week. In the discussion at the international congress at Amsterdam, in August, 1899, the maternal mortality was acknowledged to be about 1 per cent., and for the infants Barnes gave a mortality of 33 per cent., Bar 26 per cent., Becker 50 per cent., Herzman 26 per cent., and Black 50 per cent. These figures, however, are preposterously incorrect for private practice.

head,[1] although it may be by the expenditure of considerable force, after long delay, and only after prolonged molding and an adaptation of the size of the head to the size of the contracted inlet by apparent anomalies in the position and flexion of the former. It is wonderful how successfully an obstruction may be overcome even in cases of contracted pelves with a conjugate of eight centimeters or less. But while waiting for spontaneous delivery, the physician may see the uterus suddenly rupture or may find the child's head after birth seriously injured. It is permissible in most cases to wait for the full, or almost full, dilatation of the os, keeping careful watch upon the woman's pulse, temperature, and general condition, upon the situation of the contraction-ring and the distention of the lower uterine segment, and taking whatever operative measures may be required in plenty of time to forestall the possibility of uterine rupture. The application of forceps to the head above the superior strait for the purpose of securing its engagement by forcible traction should in general be condemned, but it must be admitted that there are important exceptions to this rule. If one is skilled in the application of the forceps, bears in mind the transverse position of the head, and can gage the degree of traction which may be exerted without injury to the child's skull or to the maternal soft structures, he will occasionally succeed in securing an engagement with the instrument that would otherwise, perhaps, be impossible. As a rule, however, it is safe to say that the choice lies between inaction and the performance of version. By the latter operation the smaller end of the wedge represented by the child's head is engaged in the contracted inlet, and there can be exerted upon the head coming last, both by traction on the body from below and by pressure on the head through the abdominal walls above, a degree of force that is impossible with forceps. It is well, however, to bear in mind the danger entailed upon fetal life when version is performed in a contracted pelvis. There is a considerable risk[2] that the head will be retained long enough above the superior strait, or in it, to asphyxiate the child beyond revival.[3] Or the pressure upon the head by the pelvic walls may

[1] From 1881 to 1887 there was spontaneous delivery in 163 out of 444 cases of contracted pelvis in the Vienna Hospital, and in 47 women the conjugate was not above 8.5 centimeters (Braun u. Herzfeld, "Der Kaiserschnitt u. seine Stellung zur künstlichen Frühgeburt, Wendung, atypischen Zangenoperationen, Kraniotomie bei u. zu den spontanen Geburten," Wien, 1888, ii, p. 144). In the Moscow Maternity there were 84 contracted pelves among 4000 births in 1894: 71 per cent. of these cases were spontaneously delivered (Küster, "Centralblatt f. Gyn.," No. 10, 1895).

[2] The infantile death-rate will be at least twenty-five per cent., or more likely higher (Nagel, "Die Wendung bei engen Becken," "Archiv f. Gyn.," Bd. xxxiv).

[3] Nagel reports sixty cases of version for contracted pelvis, with a fetal mortality of twenty-five per cent. (*ibid.*, p. 168).

fracture the skull and crush the brain, and the force employed in extraction may break the neck. If in the judgment of the operator the danger entailed upon the fetus by version is too great, natural forces having failed to secure engagement, and if he has tried the forceps cautiously without success, his choice must rest between pubiotomy and Cesarean section. The former will be selected only in isolated instances with most favorable conditions if the conjugate is above seven centimeters; the latter, always in cases of greater contraction than seven centimeters, and occasionally as a relative indication with a conjugate as large as 8.5 cm. These rules for the treatment of labor obstructed

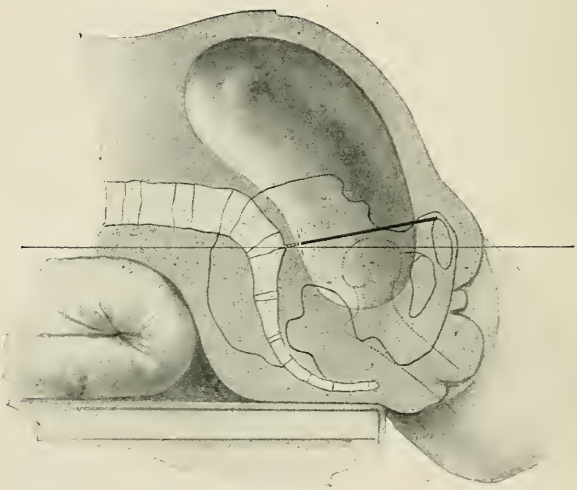


Fig. 406.—Walcher posture: the conjugate of the brim is a black line, and the amount of space gained is a dotted continuation of this line.

by a contracted pelvis presuppose, of course, a fetal body and head of average size. This point must always be investigated carefully by abdominal palpation or by mensuration of the fetal head, although it is difficult to determine.[1] If the physician has reason to believe that the child is oversized, he must allow himself sufficient latitude to insure delivery. If the child is undersized

[1] The relative size of head and pelvis may be determined approximately by the method of Müller and Schatz. The fetal head is grasped between the extended fingers of the physician, and is pressed down steadily and for some time upon the pelvic brim, the direction of the force coinciding with the axis of the superior strait. If this manœuver succeeds in pressing the head within the pelvis, then natural forces will surely secure engagement. If it fails, the converse by no means necessarily follows. Other methods of antepartum fetometry are described on page 465.

(a condition easier to detect by palpation than overgrowth), spontaneous delivery may be expected through a pelvis that would not permit the passage of a child of normal size. Klein and Walcher declare that by raising the buttocks and letting the limbs hang down as much as possible the conjugate diameter is lengthened by almost a centimeter. Clinical tests of the method are described, attended with success.[1] The Walcher posture has been indorsed by a number of observers in Germany and in

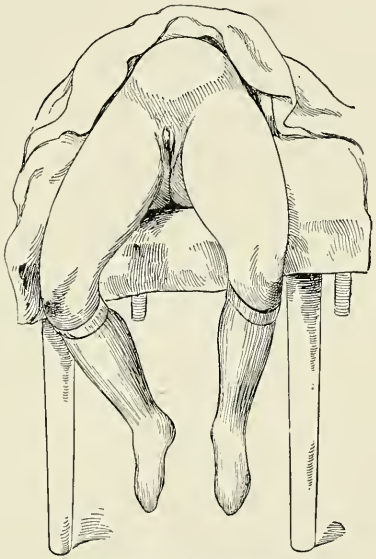


Fig. 407.—The Walcher posture.

other countries. The author has found it of decided advantage, and recommends its systematic trial.

There is a growing disposition to enlarge the indications for Cesarean section as against high forceps and version in moderately contracted pelves. I am in sympathy with this movement, but only if the operator is a well-trained abdominal surgeon with sufficient obstetric experience to judge correctly the difficulties to be anticipated in a vaginal delivery.

An exceedingly puzzling problem is presented by cases brought

[1] "Zeitschrift f. Geburts. u. Gyn.," Bd. xxi, H. 1, and "Med. Korresp. Bl. des Würtemb. Aerztl. V.," Bd. lx, 5. Lebedeff and Bartosziurcz, by experiments on 25 cadavers, found that the Walcher position lengthened the conjugate of the inlet from 1–3 mm., "International Congress for Gyn. and Obstet.," Amsterdam. Pinzani in 62 observations found an increase of 1–8 mm., *ibid.*

to a specialist after hours of obstructed labor and many internal examinations or manipulations with faulty asepsis. Cesarean section has a higher mortality in such cases, not on account of the length of labor, but because of an infected birth-canal. Frank advocates a suprasymphyseal incision and extraperitoneal delivery in these cases, reviving the idea of Joerg and Ritgen, but American surgeons, who remember the experience of Thomas and others with "laparo-elytrotomy," will be loath to accept this advice. The advocates of pubiotomy claim that under these circumstances it is a safer operation than Cesarean section, and this claim is in a measure correct, but with an infected birth-canal the difference in mortality between the two is not very striking. Personally I am in favor of Ceserean section in these cases, but with an extremely painstaking disinfection of the birth-canal and the technic of the operation carried out as described on p. 857. As an example of what can be accomplished in this way: A woman was brought to the University Hospital with the baby's arm protruding from the vulva. The head and shoulder were locked in a uterus condiformis, with the membranes long ruptured. The patient had been under the charge of an ignorant midwife and came from a filthy hovel. The vulva was cleansed, the arm disinfected and returned to the uterine cavity; the vagina disinfected and packed. A conservative Cesarean section proved entirely successful for both mother and child. The woman made an afebrile convalescence. As a rule, however, the Porro operation would be more suitable in such a case.

Obstruction to Labor on the Part of the Soft Maternal Structures in the Parturient Canal.—Congenital Anomalies of Development in the Uterus.—A double or septate uterus may complicate labor in several ways. The bulk of the unimpregnated half may obstruct delivery, especially if this half is retroverted and is increased considerably in size in sympathy with the development of the impregnated side, and is hardened in consistency by sympathetic contraction during the labor-pains. The septum itself may prove an obstacle in labor, and sometimes labor is obstructed by the strong vesicorectal ligament that runs between the horns of a bicornate uterus. If the placenta is attached to the septum, alarming hemorrhage may occur from imperfect contraction of the sparsely supplied muscular fibers in it. Malpresentations of the fetus and a faulty direction and insufficient power of the expulsive force are common. Rupture of the uterus is to be feared on account of the ill-developed uterine walls. Laceration of the septum frequently occurs. It has been noted that a decidual membrane may be retained within the non-pregnant half

of the uterus, where, undergoing putrefaction after delivery, it may give rise to septic infection. There seems also to be a disposition to the retention of membranes in the pregnant side of the womb. Retention of the placenta is not uncommon, partly because of insufficient expulsive force, partly on account of its situation,—perhaps attached in both divisions of the uterine cavity. Thévard[1] reports the retention of the placenta in a double uterus for fifty days, when it was spontaneously discharged. It has happened, in cases of double uterus and vagina, that the physician examined the wrong side, and was ignorant of the progress of labor until the child was about to be born; also that he examined first one side and then the other, finding first a dilated and then a contracted external os.

In one woman with a double uterus there was noted a disposition to become pregnant in regular alternation first on one side and then upon the other.[2] It is said that ovulation in these cases occurs in one ovary one month; in the other, the next.[3]

Closure and Contraction of the Cervix.—The cervix may obstruct labor by reason of atresia, cicatricial infiltration, contraction, and rigidity, or there may be longitudinal or transverse septa in the canal. Atresia of the cervix in a pregnant woman is acquired after impregnation (*conglutinatio orificii uteri externi*); it is rarely, however, complete. There is always an indication at least of the external os in a dimple evident to the sense of sight if not to that of touch. By pressing upon this point with a fingernail or with the tip of a uterine sound, a small artificial opening may be made. Directly this is secured, the dilatation of the external os proceeds in a remarkably rapid manner, although hours of vigorous labor-pains before had been insufficient to begin it. If this plan fails, a crucial incision must be made in the cervical tissues at the site of the external os. The dilatation of the small opening thus made is then left to nature. If hemorrhage follows the incisions, the bleeding points should be secured by sutures after the conclusion of labor. An active treatment is always called for. Without it the uterus may rupture, the vaginal portion of the cervix may be torn off from the womb, or the head may emerge completely covered by the enormously distended cervix as by a caul.[4] *Cicatricial contraction* or *infiltration* of the cervix is the result of old, unre-

[1] "Nouvelles Archives d'Obstétrique et de Gynécologie," 1890, p. 640.

[2] Southermann, "Berliner med. Wochen.," 1879, 41.

[3] Guérin-Valmale, "De l'evolution de la puerperalité dans l'uterus didelphe," "L'Obstetrique," May, 1904.

[4] Jeutzen, "Archives de Toxicologie," Paris, 1890, II. 8.

paired tears, of operations upon the cervix, of cauterization, of syphilis, or of cancer. In the first instance the resistance to dilatation is scarcely ever great, and what there is may be almost always overcome by hydrostatic dilators, by the application of the forceps and forcible delivery of the head through the cervical canal, or by the performance of version followed by rapid extraction. If the cicatrices are of syphilitic or of cancerous origin, the obstruction is more serious. It may be overcome by radiating incisions with scissors or with a probe-pointed bistoury, but it is not unlikely to demand the performance of abdominal or vaginal Cesarean section.

Rigidity of the cervix is seen normally in all primiparæ, and to an exaggerated degree in elderly primiparæ. It yields often to copious douches of warm water directed against the anterior wall of the cervix and frequently repeated—as often as once every fifteen minutes if necessary. Chloral internally and belladonna ointment applied directly to the cervix have been recommended, but these remedies are not to be depended upon except in the slight rigidity characteristic of all primiparæ. If there is delay in such cases, fifteen grains of chloral every fifteen minutes for three doses may advantageously be given. An anesthetic, after all, is the most valuable medicinal agent that we possess for the relaxation of this as well as of other rigid tissues. The rigid cervix yields at length to the steady pressure of the presenting part, and it is rarely necessary on account of rigidity alone to resort to artificial dilatation or to incisions. In the course of a slow dilatation of the cervical canal and external os the anterior lip may become incarcerated between the head and the pelvic walls. In consequence of the pressure and the disturbance of circulation in the part the cervical tissues rapidly become edematous, and the bulk of the anterior lip becomes so great as actually to constitute a mechanical obstruction to the descent of the head. It is usually possible in such cases to push up the anterior lip over the head and above the symphysis in the intervals between the pains. If there is hypertrophy of the anterior lip in consequence of an old laceration and eversion, or, all the more, should there be hypertrophy of the whole infravaginal portion of the cervix, the obstruction may become quite serious, and it may be impossible to push the cervix above the head. In such cases forcible traction on the forceps or radiating incisions in the cervix may be necessary.

Longitudinal septa in the cervical canal are usually seen with duplicity of the uterine cavity from failure of the Müllerian ducts to fuse completely. Occasionally the lack of fusion is confined to the cervical canal alone (*uterus biforis*). Rarely, transverse

septa have been found in the cervical canal.[1] It may be necessary to cut them before the child can pass into the vagina.

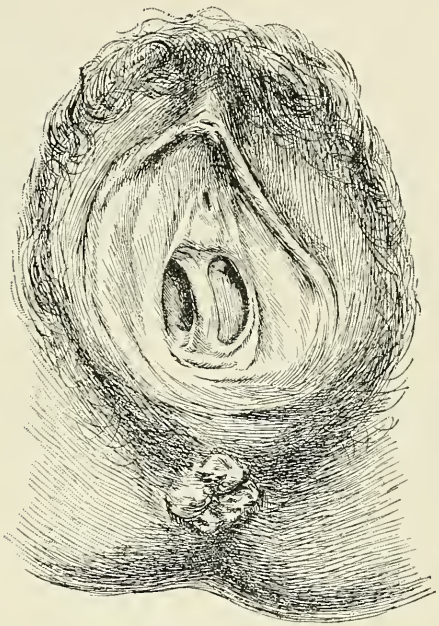


Fig. 408.—Double vagina.

Closure and Contraction of the Vagina or Vulva.—There may be obstruction of the lower birth-canal by longitudinal and transverse septa, by cicatrices, by hematomata, by partial atresia, either congenital or acquired, by unruptured hymen, by anus vaginalis, by vaginal tumors and cysts, by cystic and solid tumors of the vulva, by enlarged caruncule myrtiformes, by varices, by vaginismus, by congenital narrowness of the vagina and vulva, and by rigidity of the tissues, especially in elderly primiparæ.

Longitudinal and transverse septa are not ordinarily very dense in structure, and they give way commonly before the advance of the presenting part. If they do not yield, it is easy to cut them in one or more places, the hemorrhage being controlled, if necessary, by sutures afterward, or, in the case of transverse septa, by a double ligature applied first, the septum being

[1] Cases are reported by Müller, Breisky, Budin, Henry, Bidder, and Blanc (Pozzi's "Gynecology," vol. ii, p. 456).

cut between, though there is not much tendency to bleeding even in those as thick as one's finger (Fig. 409).

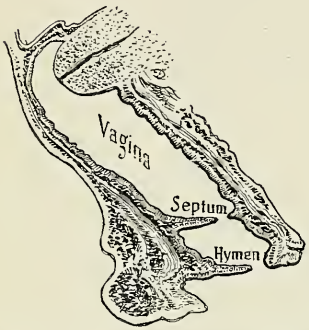


Fig. 409.—Transverse septum of the vagina (Heyder).

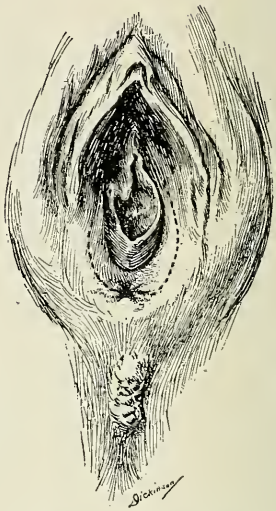


Fig. 410.—Anus vestibularis. Dotted lines show the limit of mucous membrane; thickened skin marks the normal site of the anus (Dickinson).

Hematomata.—Hematomata of the parturient tract usually occur at the vaginal orifice, and most often between the birth of twins. They are considered here only as mechanical obstacles to labor. If the blood-tumor is large enough to constitute an obstruction to the escape of the child, its walls must be incised and its contents be turned out, and if hemorrhage follows, it must be checked by a firm tampon, preferably of iodoform gauze, in the cavity of the tumor.

Extensive cicatrices in the vagina from syphilitic, malignant, or other ulceration, or from former injuries, may be stretched sufficiently by hydrostatic dilators or may be severed by multiple incisions, followed by the application of forceps if the head is presenting; but they may be too dense and extensive to yield to these measures, and a Cesarean section may be required.

Unruptured Hymen.—An unruptured hymen is not necessarily a bar to conception. There are a number of cases on record in which a persistent hymen with a small orifice has obstructed to some degree the escape of the child's head in labor. In two cases under the author's notice the advance of the pre-

senting part ruptured the hymeneal membrane without difficulty, but it has been found necessary by others to incise it.[1]

Atresia of the Vagina.—The canal may be obstructed by an annular membrane like the hymen. Although Cesarean section has been done for this condition, it is not required. The advance of the presenting part has dilated the narrowed vaginal canal with less difficulty than it experiences in dilating the cervical canal. The author has seen three cases. At the worst, the obstruction should be overcome by digital, instrumental, or hydrostatic dilatation. In complete or almost complete acquired atresia of the lower portion of the vagina, in which insemination has taken place by way of a dilated urethra and a vesicovaginal fistula, the imperforate portion of the vagina may be opened by a transverse incision, the rectum and bladder being guarded by a finger in the one and a sound in the other. In a case of acquired stenosis of the vagina in which the canal throughout its whole length was narrowed to a sinus barely admitting a probe, the author was obliged to do a Cesarean section.

Anus vaginalis or vestibularis may complicate labor by the accumulation of feces in the rectum, due to the unnatural position of the anus (Fig. 410). In one case in which this anomaly was associated with contraction of the vulvar orifice it was necessary to cut the perineal structures upward from the rectum toward the pubis, in order to permit the escape of the child's head.

Cystic and Solid Tumors of the Vagina and Vulva, Edema, Elephantiasis, Suppuration, and Gangrene.—In the case of solid tumors excision may be necessary, by transfixing the pedicle if they have one, and ligating it to prevent hemorrhage, or by an incision of the vaginal wall over them and their enucleation, followed by the immediate extraction of the child, and the control of hemorrhage by the needle and thread or by direct pressure. In a case of elephantiasis vulvæ under the author's care there was no difficulty in labor. The labia were amputated two weeks afterward. In the case of large cystic tumors a puncture is sufficient to remove the obstruction. Güder[2] collected 60 cases of vaginal tumors complicating labor—23 cysts and echinococcus sacs; 18 fibroids, fibromyomata, and polypi; 14 carcinomata, 1 sarcoma, and 4 hematomata. Delivery was accomplished by the following diverse methods: Spontaneously, 14; by forceps, 18; by version and extraction, 2; by traction on the feet, 1; by removal

[1] Ahlfeld, "Zeitschrift f. Geburtshülfe und Gynäkologie," Bd. xxi, p. 160; *ibid.*, Bd. xiv, p. 14.

[2] "Ueber Geschwülste der Vagina als Schwangerschaft und Geburtskomplikationen," "Diss.-Inaug.," Bern, 1889.

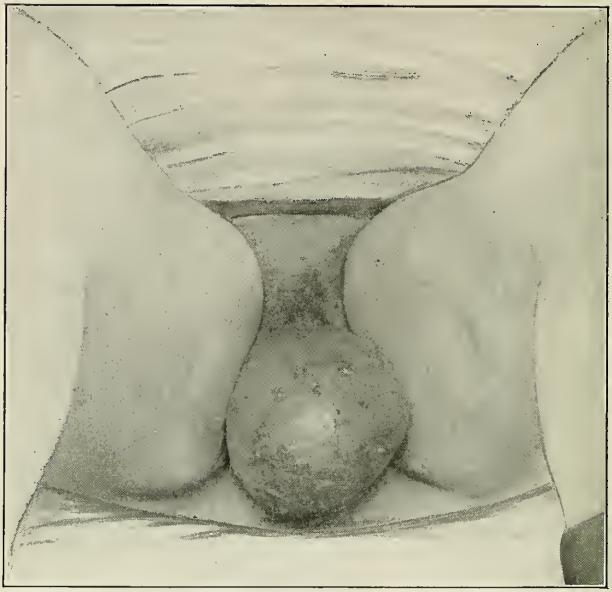


Fig. 411.—Cyst of the right labium majus (author's case).

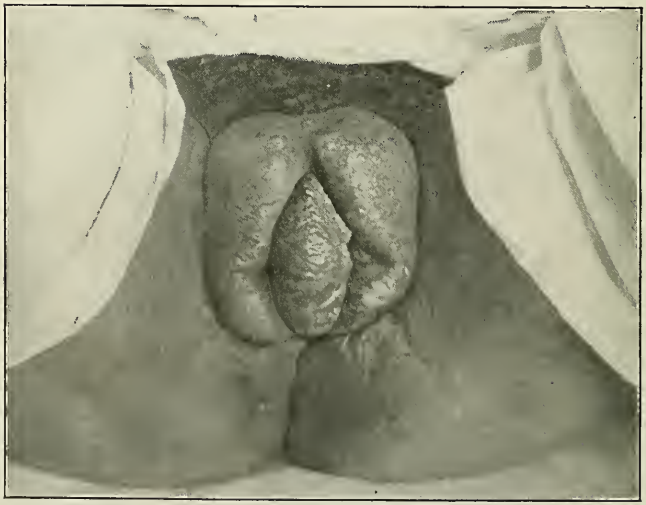


Fig. 412.—Elephantiasis vulvæ (author's case).

or puncture of the tumor, 16; by Cesarean section, 7; by induction of premature labor and craniotomy, 2; by premature labor, 3; by laparo-elytrotomy, 1; by craniotomy 1; by pushing back the tumor and extracting the child past it, 2. Among the mothers there were 15 deaths; among the children, 13. In 11 of the mothers and in 22 of the children the result was not reported.

Edema of the vulva may be the result of kidney insufficiency

Fig. 413.—Edema and beginning gangrene of the vulva from prolonged pressure in an obstructed labor. Cesarean section (author's case).

or of pressure in a prolonged labor. The increased bulk of the dropsical labia may interfere with the escape of the presenting part, or, what is more likely, the edematous tissues lose their elasticity, obstruct labor by their rigidity, and are prone to deep tears at the time of birth and to gangrene afterward. Punctures or incisions in the labia may be necessary to escape more serious injury, but it is well to avoid them if possible, for they are apt to be followed by infection and gangrene.

An abscess of Bartholin's gland is seldom large enough to retard labor, though it has done so (Müller), but it is likely to cause trouble afterward. It should be opened freely in the early part of the first stage of labor, curetted, swabbed out with carbolic acid and glycerin, and packed with iodoform gauze, or, better, completely exsected by a deep dissection.

Gangrene of the vulva is very rare before the termination of labor. Should it exist, it might determine an operator in favor of Cesarean section in a doubtful case, on account of the rigidity

of the vulvar tissues, the certainty of laceration, and the likelihood of grave infection.

Enlarged Caruncule Myrtiformes and Varicose Veins.—These tumors do not possess sufficient bulk, as a rule, seriously to obstruct the last stage of labor. They may, however, be so bruised by the passage of the head as to slough afterward, or the veins in them may be ruptured, giving rise to subcutaneous or frank bleeding of an alarming character.

Vaginismus may be overcome by an anesthetic. *Congenital narrowness* of the vagina and vulva is usually overcome by the advance of the presenting part, though often at the expense of vaginal and perineal lacerations. It may be necessary to resort to hydrostatic dilatation, or even, in rare instances, to Dührssen's plan of multiple incisions. In the case of extreme narrowness of the vulva there may be a central tear of the perineum, through which the presenting part begins to emerge. To avoid a rectal tear in such a case the perineum should be cut from the anterior border of the perforation to the posterior commissure of the vulva (Fig. 414).

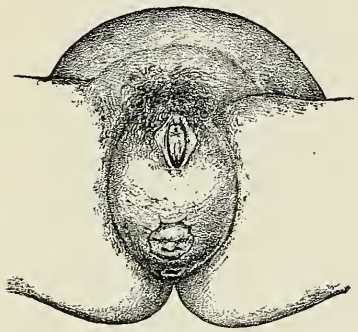


Fig. 414.—Central tear in the perineum, with contracted vulvar orifice (Ribemont-Dessaignes).

Rigidity of the tissues in the cervix, the vaginal wall, and at the outlet occasions delay in the majority of all primiparæ, but especially in the case of elderly primiparæ—those over thirty years of age. Eckhard found the infantile mortality in such cases to be 19.81 per cent., the maternal mortality to be three times as great as in younger primiparæ; and the necessity for operative interference increases steadily with the age of the primiparæ until, in those past forty, almost two-thirds are delivered by some operative procedure, usually forceps. Craniotomy should be done if the child is dead. Version is the least successful operation in these cases.

Displacements of the Uterus.—The uterus in labor may be displaced forward; to either side; downward; or backward, by the so-called "sacculation" of the womb. It may be twisted on its pedicle, the cervix, or it may form part of the contents of a hernial sac in inguinal or ventral herniæ.

Anterior Displacement of the Uterus in Labor; Pendulous Belly.—This is a common anomaly in labor, seen to some degree in all cases of obstructed labor, as in deformed pelvis, and in all cases in which the length of the abdominal cavity is decreased, as in kyphosis. A peculiar example of forward displacement is seen in those rare instances of hernia of the parturient womb between the recti muscles or to one side of the median line during the second stage of labor (Fig. 415). The pregnant womb

Fig. 415.—Hernia of the gravid womb (Rosner).

may fall forward also into an umbilical hernia or into a ventral hernia following celiotomy.

The removal of the obstruction to labor in the first class of cases ordinarily obviates the anterior displacement. If the displacement depends not upon obstruction, but upon flaccid abdominal walls, the application of an abdominal binder corrects the anteversion. In cases of hernia of the uterus through the anterior abdominal wall, artificial delivery with forceps or by

version may be necessary; when the uterus is evacuated, it can easily be returned into the abdominal cavity. A tight abdominal binder and the diminution of intra-abdominal pressure after delivery promotes the approximation of the separated recti muscles. In inguinal hernia the pregnant womb in the hernial sac is usually unicorn or bicorn (Fig. 416). Delivery may be effected by version, and this may be followed by a reduction of the hernia, but it is best to lay open the sac, incise the womb, extract its contents, and then amputate it. Adams [1] has collected ten cases of inguinal hernia of the gravid womb, including Doringius's, which he calls "crural." In eight Cesarean section was done; in one the delivery was spontaneous.

Labor Complicated by a Former Operation to Suspend or Fix the Womb Anteriorly.—The number of operations performed for posterior displacement of the uterus on women of child-bearing age has become so large of recent years that ample opportunity has been afforded to judge of the influence of anterior fixation

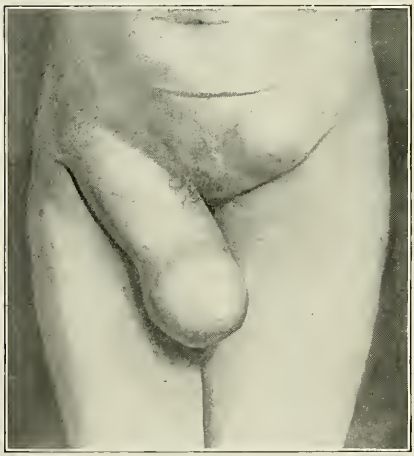


Fig. 416.—Inguinal hernia containing a gravid womb (Winckel).

and suspension of the uterus on pregnancy and childbirth. Dorland [2] has collected the statistics of 179 pregnancies following operations for ventrosuspension, ventrofixation, and vaginal fixation. It appears from these statistics that, the firmer the womb is fixed and the lower the fundus is fastened, the more certainly will there be serious disturbances in pregnancy and dangerous

[1] Adams, "Hernia of the Pregnant Uterus," "Amer. Jour. Obstetrics," vol. xxii, p. 225.

[2] "University Med. Mag.," Dec., 1896.

complications in labor. Thus, abortion occurred in 14 per cent. of the ventrosuspensions and in 27 per cent. of the vaginal fixations. In 12.29 per cent. of all the cases there was dystocia, requiring in three instances Cesarean section. The complications noted in labor were: inertia uteri, transverse position of the child, abnormal positions of the head, cervical rigidity, uterine rupture, placental anomalies, postpartum and puerperal hemorrhages, and a mechanical obstruction in labor from the thick anterior wall of the uterus, held firmly down over the pelvic inlet, the distention of the uterus in pregnancy having been accomplished by the expansion mainly of the posterior uterine wall. Pregnancy was seriously disturbed in 8.37 per cent. of the cases, not including those in which abortion occurred, by pain and traction at the site of the incision, dysuria, and excessive nausea and vomiting.

A sure indication of the difficulty to be expected in labor is afforded by the behavior of the fundus and cervix of the womb in pregnancy. If the former remains fixed over the pelvic inlet and the latter is steadily drawn upward and backward until it reaches the promontory of the sacrum or actually ascends above it, the labor will be so seriously complicated in all probability that, in the hands of an expert abdominal surgeon, the best results may be obtained by opening the abdomen and severing the adhesions between the fundus uteri and the abdominal wall. If version is demanded in labor at term, great care must be exercised not to rupture the overstretched posterior uterine wall.

The best preventive treatment of difficulty in pregnancy and labor after the operative treatment for posterior displacement is the choice of the appropriate operation and its proper performance. Vaginal fixation should not be selected. Shortening of the round ligaments has not yet given rise to any difficulty in subsequent pregnancies and labors,[1] nor has ventrosuspension, properly performed. If the operator uses fine celloidin linen thread and includes only a portion of the rectus muscle with the peritoneum in the abdominal portion of the stitch, the artificial suspensory ligament is so flexible and stretches so easily that no difficulty need be apprehended if the patient conceives. In more than 700 operations by the author for retrodisplacement there has been only one case in which there was a complication traceable to the operation in pregnancy and labor, and this was not much more than serious inconvenience during the first six months of pregnancy from drag upon the suspensory ligament.

[1] Stratz has reported one case of difficulty from a thickened inflamed right round ligament, but the woman had gall-stones and jaundice, and it is not clear that the symptoms were referable to a former Alexander operation. "Centrbl. f. Gyn.," No. 28, 1900.

Lateral Displacement.—A tilting of the uterus to the right side is a physiological occurrence in pregnant and parturient women. The lateral inclination is sometimes exaggerated to such a degree that a great part of the expulsive force is lost by the propulsion of the presenting part against the lateral wall of the pelvis. The displacement may be corrected by turning the woman on the side—usually the right—toward which the fundus uteri is inclined, and placing under her flank a rolled blanket or a pillow.

Sacculation of the Uterus.—A backward displacement of the gravid womb in rare cases goes on to full development by what is called "posterior sacculation," the distention of the uterus to accommodate the full-grown fetus being accomplished by stretching the anterior uterine wall, the posterior wall and the fundus remaining fixed within the pelvis (Fig. 419). In these cases the cervix is high above the pelvic inlet and is pressed close against the anterior abdominal wall, the posterior vaginal wall bulges outward and downward, and fetal parts can be felt through it with a distinctness that suggests abdominal pregnancy. Cesarean section has been performed on account of this anomaly, but a study of recorded cases shows it to be, as a rule, unnecessary. By the artificial dilatation of the cervical canal and the performance of podalic version, delivery may be effected without difficulty.

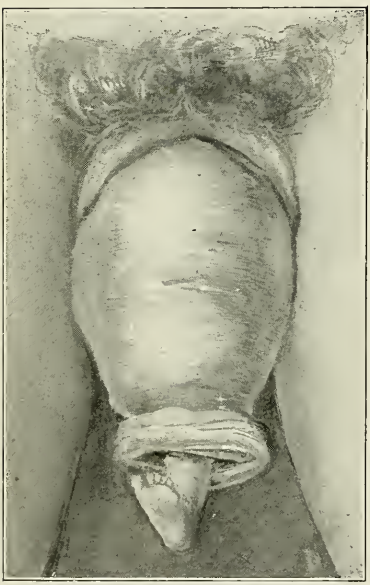


Fig. 417.—Partial prolapse of the womb in labor (Wagner).

Partial Prolapse with Hypertrophic Elongation of the Cervix.—It is impossible for pregnancy to proceed to term with complete prolapse of the womb, although the size of the uterine tumor projecting from the vulva in some cases has given rise to a belief in this possibility (Fig. 417). A careful examination has always shown the major portion of the uterine body to be within the pelvic and abdominal cavities. Commonly, the fundus is at a normal level, and the descent of the cervix has been accomplished by stretching the lower uterine segment and by hypertrophic elongation of the cervix itself. When the contraction of the

uterine muscle begins in labor, a partial prolapse of the womb is usually spontaneously corrected by the retraction of the cervix

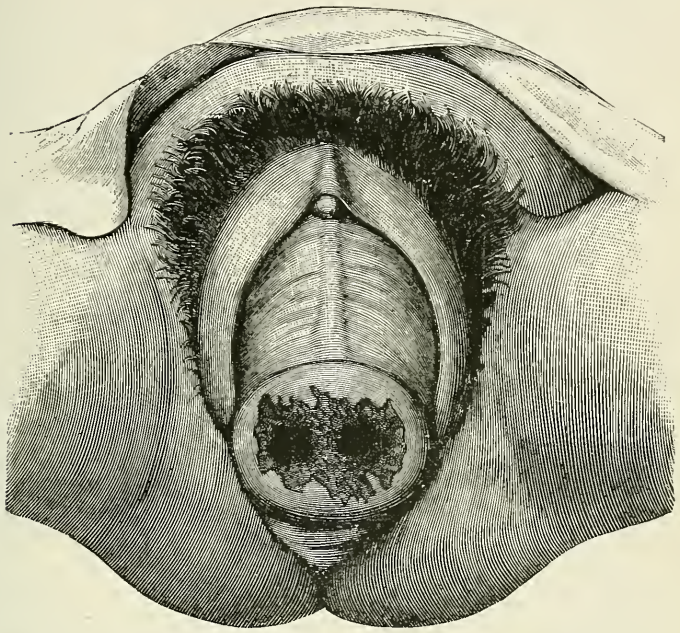


Fig. 418.—Prolapse of a double uterus in a pregnant woman (Maygrier).

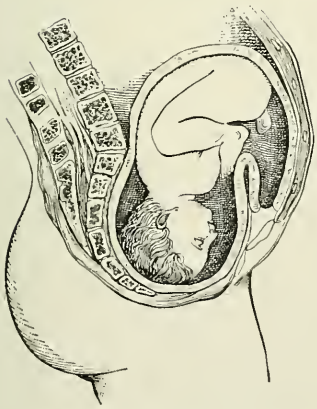


Fig. 419.—Sacculation of the uterus (Oldham).

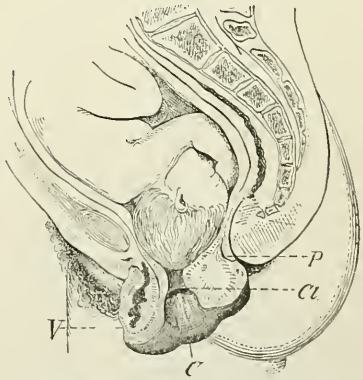


Fig. 420.—Partial prolapse of the womb and hypertrophy of the cervix (Faivre).

within the vagina. This the author has seen in several instances. In exceptional cases, however,—usually on account of a rigid cervix,—the prolapse becomes aggravated or suddenly makes its

appearance, and the cervical tissues, growing edematous and becoming enormously swollen, constitute, by their bulk and increased rigidity, a serious obstruction to the delivery of the child.

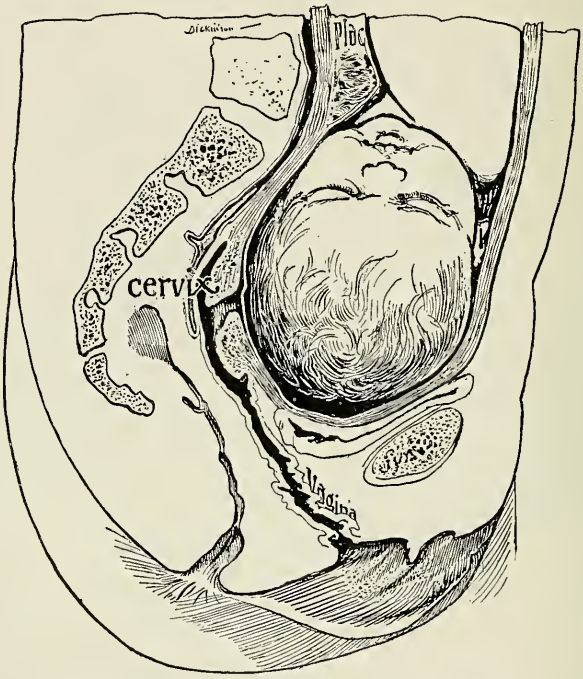


Fig. 421.—Displacement of the cervix (Dickinson).

This difficulty was overcome in an ingenious manner in a case reported by Faivre.[1] The woman was placed in the dorsal position across the bed, a forceps was applied to the child's head, and an assistant, standing astride the woman's body, hooked his fingers into the cervix and pulled upward to counteract the traction of the forceps upon the child's head and the incarcerated cervical tissues. It may be necessary in such a case to enlarge the cervical canal by radiating incisions. The hemorrhage following is controlled temporarily by clamping sutures over the wounded surfaces without uniting them (Fig. 420).

Displacement of the Cervix.—It is not uncommon, in primiparæ with a narrow cervical canal, for the cervix to be displaced backward, so that the external os, almost inaccessible to the examining finger, points directly backward or even backward and upward. The anterior lower uterine segment is much distended

[1] "Nouvelles Archives d'Obstétrique," 1890.

by the presenting part and occupies the whole vaginal vault. The expulsive force in labor is exerted against the lower uterine segment, and the cervical canal remains undilated. The difficulty may be overcome by applying an abdominal binder and by hooking the cervix forward with the finger during two or three pains (Fig. 421).

Tumors of the Genital Canal.—*Carcinoma of the Cervix.*—In 34 per cent. of the cases cancer of the cervix interrupts gestation at various stages (Müller). If the disease is not too far advanced; if it is confined to one lip of the cervix, and that the anterior; and if there is not too much cicatricial infiltration around its periphery and the cervical walls, labor may be terminated spontaneously, but this is exceptional. The performance of Cesarean section is commonly the proper treatment for labor obstructed by carcinoma of the cervix, and this operation should be selected if there is good reason to doubt the possibility of spontaneous or artificially assisted delivery by the natural passage-way. If the disease is far advanced, the woman's life is surely doomed in the near future, and the child at any rate should be saved, even at considerable risk to the mother. It may be desirable to operate before the fetus has reached maturity, if the disease is making such rapid progress that the woman is likely to die before the natural end of pregnancy, or if the cancer is still in the operable stage. An abdominal or vaginal panhysterectomy should follow the Cesarean section, if possible.

Fibromata.—Fibroids of the uterus and cervix low enough in situation to become incarcerated in the pelvis are likely to be insuperable obstructions in labor, besides complicating parturition by favoring abnormal positions of the child, by predisposing to adherence of the placenta, to prolapse of the extremities and cord, to hemorrhage during and after labor and to infection. If the tumor grows on the anterior wall of the uterus, the first few labor-pains and the contraction of the longitudinal fibers of the cervix may dislodge it above the pelvic brim, though it had been impossible to do this before by manipulation. It is also possible for tumors on the anterior wall of the cervix to be pushed out of the vulva in front of the presenting part, thus making room for the escape of the latter. If, however, the tumor is situated laterally or posteriorly, its artificial displacement upward into the abdominal cavity, so that the child may escape past it, is often impracticable (Fig. 422). On the contrary, the attempt at descent of the presenting part in labor may fix it more firmly in the pelvic cavity.[1] In

[1] It is barely possible that a tumor low down on the posterior wall of the cervix, the most unfavorable of all positions, may be suddenly elevated after many hours of labor, and thus allow a spontaneous delivery; but this event is not to be counted on in practice.

this case, if attempts under anesthesia to dislodge the tumor and to push it above the pelvic brim fail, a Porro-Cesarean operation should be performed, even though the tumor is not so large as absolutely to prevent the delivery of the child. The physician must consider the effect upon it, owing to its low vitality, of the pressure to which it will be subjected by dragging the child past it (Fig. 423). Sloughing, gangrene, and fatal in-

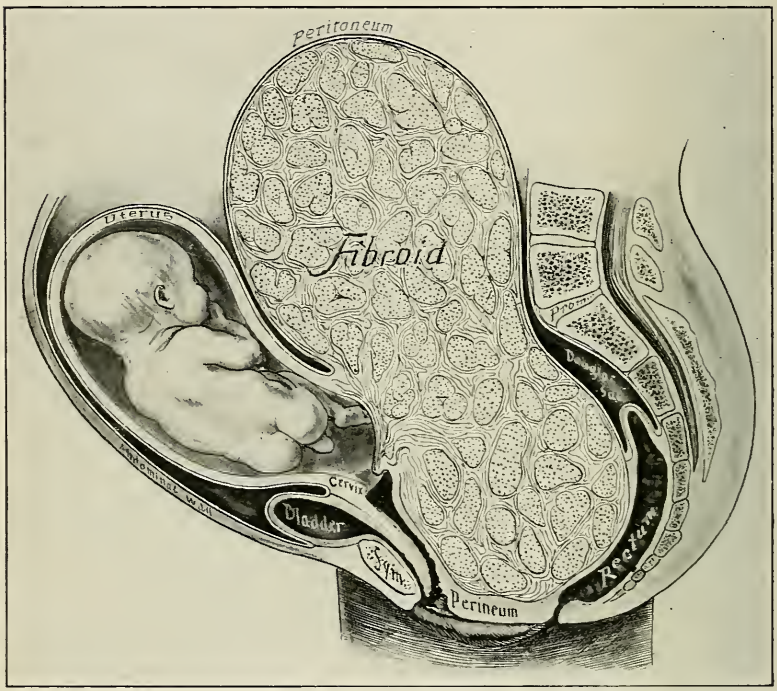


Fig. 422.—Large fibroid blocking the pelvis (Spiegelberg).

fection are likely to follow. This was the history of the case illustrated in figure 423, communicated to the author by Dr. J. P. Simpson, of South Carolina. If the fibroid is submucous and grows from the cervix, it may be enucleated when labor begins. The bed of the tumor should be packed with gauze after labor.[1]

It is, unfortunately, a common error to overlook a fibroid tumor obstructing the pelvis in labor, or to mistake it for the

[1] Sutugin is an enthusiastic advocate of vaginal operations for all cases of fibroids impacted in the small pelvis. For intramural tumors the cervix is split until the tumor is reached. For subserous tumors the vaginal vault is opened. Nine such operations *sub partu* are reported with only one death (Jahresb. ü. d. Fortsch. a. d. Gebiete der Geburtsh.," etc., vol. v, p. 175).

fetal head. The woman is allowed to die of ruptured uterus, exhaustion, or hemorrhage, while the physician is waiting for the descent of the presenting part, or is endeavoring to apply the forceps to what he takes to be the head. Ordinary care and a little experience in making obstetrical examinations should guard a practitioner against such an egregious mistake.

The prognosis of labor complicated by a fibroid tumor depends upon the early recognition of the growth and upon the treatment. In general practice the results have hitherto been bad. Nauss found a maternal mortality of 54 per cent. among 225 women and an infantile mortality of 57 per cent. in 117 cases. Süsserott found in 147 cases a maternal mortality of 50 per cent. and an infantile mortality of 66 per cent.[1]

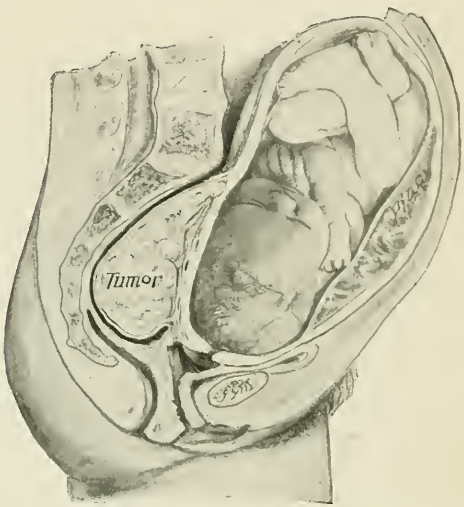


Fig. 423.—Small fibroid past which the child was extracted. The tumor became gangrenous, and the woman died (Simpson).

In Lefour's statistics of 300 cases of fibroids complicating labor, the mortality of delivery by the natural passage was 25 to 55 per cent. for the mothers, 77 per cent. for the children.[2]

A fibroid tumor may prolapse into the pelvis after the birth of the child and prevent the delivery of the placenta. The author has performed Cesarean section (Porro) twice, myomectomy twice, and hysterectomy four times in the puerperium for fibroids complicating the child-bearing process without a death, although in four cases the tumor was necrotic.

The tumor may practically disappear during the involution of the uterus. Every year the author sees a case or two of spontaneous cure in this way. There is, however, a strong disposition to infection after labor in the weakly resisting structure of a fibromyoma.

[1] Sutugin, *loc. cit.* A valuable table of statistics showing the result of various treatments for fibroids in the child-bearing process was presented by Armand Routh at the British Medical Association Meeting in 1903. See also Tate, "Am. Journ. of Obst.," November, 1902; Partridge, "Prov. Med. Journ.," Sept., 1903.

[2] Phillips, "Brit. Med. Journ.," 1888, i, p. 331.

Polypi.—Polypoid tumors obstructing labor usually spring from the cervical canal or the anterior lip of the cervix, and are commonly mucous in character. They may, however, be fibromyomatous, fibrous, or sarcomatous, and may have a situation high in the uterine cavity or in its wall. They may increase very markedly in size during pregnancy. The pedicle is usually small, and in the case of cervical polypi their removal is easy. The operation should be postponed, however, until the woman falls into

Fig. 424.—Large subperitoneal fibroma reaching from the fundus uteri to the liver; removed by myomectomy on tenth day of puerperium for infection (recovery).

labor, for any operative interference in this region would very likely interrupt gestation. When the dilatation of the os begins, the pedicle may be transfixed and ligated and the tumor be cut away. Even if these growths are not sufficient in bulk to obstruct parturition mechanically, they have been known to give rise to profuse hemorrhage in the first few days of the puerperium, and their removal is desirable, therefore, even though they be small in size. In the case of fibromyomatous polypi of the uterine body, the tumor has on rare occasions been torn from its pedicle during labor and has been expelled in front of the child.

The non-pregnant half of a uterus bicornis or didelphys may hypertrophy to such an extent as to obstruct labor, cause rupture

of the pregnant uterus, or demand Cesarean section. If the nature of the obstruction is recognized, the non-pregnant portion of the uterus may be pushed out of the way. If this is impossible, Cesarean section, followed by amputation of the non-pregnant side of the uterus, is indicated.[1]

Tumors of Neighboring Organs.—*Ovarian Cysts.*—An ovarian cyst is a rare complication of labor. In 17,832 births in the Berlin Frauenklinik, an ovarian cyst was found only five times. McKerron,[2] however, was able to collect 1290 cases of ovarian tumor complicating the child-bearing process. The number of abortions in pregnancies complicated by ovarian cysts is somewhat larger than common. Of 321 pregnancies complicated

Fig. 425.—Subperitoneal fibromata. The growth attached to the lower uterine segment was impacted in the pelvis, insuperably obstructing labor. Celiohysterectomy: woman recovered, although she had been in labor four days; child dead (author's case).

by ovarian cysts, there was premature interruption in 55 (Remy). If the cyst is discovered during pregnancy, its removal should be attempted. Ovariotomy during gestation is not necessarily a

[1] G. S. Brown, "Surgery, Gyn. and Obstet.," September, 1906.
[2] "Pregnancy, Labor and Childbed with Ovarian Tumor," London, 1903.

difficult or dangerous operation, nor does it, as a rule, interrupt pregnancy.[1] If the tumor is first discovered after the woman has fallen into labor, and if it has been displaced downward into the pelvic cavity and is incarcerated, resisting all efforts to displace it upward, even under anesthesia, it is better to perform a Cesarean section, followed by the removal of the tumor.[2] By this plan many dangers in the puerperium are escaped. Twisted pedicle, intracystic bleeding and shock, occlusion of the bowels, rupture of the cyst, suppuration of the cyst-contents, and consequent peritonitis are all surely avoided. A number of cases treated thus should give a better mortality record than has hitherto been

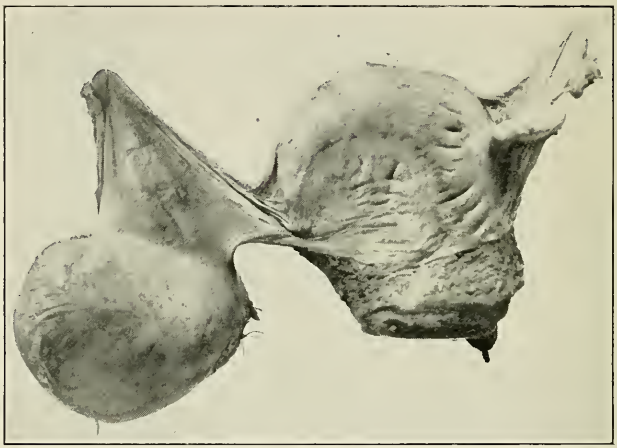


Fig. 426.—Dermoid cyst containing hair and teeth and puerperal uterus, removed in a Porro-Cesarean section (author's case).

secured. Another plan of treatment which has yielded good results is vaginal ovariotomy, if the tumor is of moderate size. The posterior vaginal vault and Douglas' pouch are opened, the tumor is punctured and extracted collapsed, the pedicle is ligated, and the

[1] Dsirne has collected statistics of 135 operations with a mortality of 5.9 per cent. Pregnancy is interrupted by the operation in about 20 per cent. of cases (Flaischlen, "Zeitschrift f. Geburtshülfe," xxix, p. 49). Heil's statistics of 241 operations gives a mortality of 2.1 per cent. and interrupted pregnancy in 19.47 per cent. ("Münch. med. Wochenschr.," Jan. 19, 1904).

[2] I have performed Cesarean section twice for large dermoids impacted in the pelvis obstructing labor, with a successful result for both mother and child. My experience in ovarian cysts complicating the childbearing process amounts to ten operations in nine individuals: two, small dermoids, removed in pregnancy; 3 operated on in labor; 2 Cesarean sections: one vaginal puncture, the latter being a multilocular cyst, the two former, dermoids; 5 removed in the puerperium on account of infection. One of the last named died from septic intoxication, the only fatal result. One was removed on the sixth day of the puerperium on account of gangrene and peritonitis, the result of a twisted pedicle.

tumor excised. The vaginal wound is either packed with gauze and united after delivery or closed before the extraction of the child. In Heiberg's statistics of 271 cases there was a maternal mortality in pregnancy of more than 25 per cent. and a fetal mortality of more than 66 per cent. In deliveries by forceps without puncture of the cyst the maternal death rate has been 50 per cent.; with puncture, almost as great; and after version without puncture, more than 50 per cent. Flaischlen recommends the vaginal puncture, or, if necessary, a vaginal incision and thorough evacuation of the tumor, then the delivery of the child, and on the following day, at the latest, an abdominal section for the removal of the tumor. This procedure does not seem to me so good a plan as the coincident Cesarean section and ovariectomy. Should the physician prefer vaginal puncture—which requires, of course, no special surgical skill—he should remember that if the tumor is densely adherent, possesses thick walls, and possibly is a dermoid cyst, puncture through the vaginal vault is likely to be followed by gangrene of the tumor contents and walls and by general infection. The infection of the tumor necessitates a hurried abdominal section in the puerperium, with the patient in a bad condition to endure it. Moreover, if the cyst is multilocular, it may be impossible to reduce its size sufficiently by vaginal puncture to permit the delivery of a living infant. The author has experienced both the disadvantages of this plan of treatment.

It has been claimed that an ovarian cyst obstructing labor should be removed by celiotomy and that then the labor should be terminated by the natural passage, but to subject a woman to a labor that might prove tedious and exhausting or might require a difficult forceps operation directly after an abdominal section is not good surgical judgment.

Spontaneous delivery in spite of an ovarian cyst incarcerated in the pelvis has been noted after the cyst ruptured, after it had been spontaneously dislodged upward above the pelvic brim, or had ruptured the vaginal vault or the rectum. As an ovarian cyst must be impacted in the pelvis to obstruct the delivery of the child, it is easily understood that there is more difficulty and danger in labor from a small than from a large tumor (Fig. 427). After the child is born, a cyst that had before been above the brim may descend into the pelvis and obstruct the delivery of the placenta.

If the ovarian cyst has not been removed during pregnancy, is in the upper part of the abdomen, out of the way in labor, it may be disregarded until the woman is delivered. It is good practice to remove it in the first 48 hours of the puerperium, thus

avoiding the possibility of twisted pedicle and infection, or at the latest as soon as the puerperal convalescence is completed.

Vaginal Enterocele.—Vaginal hernia is a very rare obstruction in labor. The author has been able to collect but 27 cases from medical literature. Of these, only two were anterior enteroceles ; the others were lateral and posterior. The distention of the hernial sac in labor is apt to become excessive, and to threaten its rupture with protrusion of intestinal loops. An effort should be made to reduce the hernia as soon as it is discovered. The reduction may be facilitated by placing the woman in the knee-breast posture and by inserting the whole hand into the vagina. If this treatment is instituted in pregnancy, it should be followed by the insertion of a large tampon or a globe pessary and by prolonged rest in bed ; in labor the presenting part should immediately be brought down past the hernial ring. If there are adhesions about the latter, preventing the reduction of the hernia,

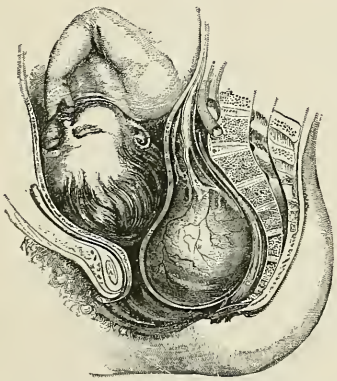


Fig. 427.—Ovarian tumor incarcerated in the pelvis during labor.

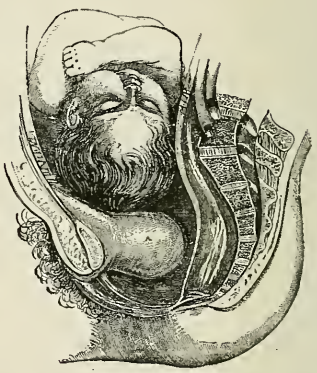


Fig. 428.—Cystocele obstructing labor.

the tumor should be supported and held to one side by assistants while the child is artificially extracted by forceps or after version. Should the sac rupture and the intestines protrude, the child must be delivered hastily, the intestines be cleansed thoroughly and replaced, and the opening be sewed up. In the case of a very large irreducible vaginal hernia, Cesarean section would be preferable in a labor at term.

Other growths or tumors in the pelvic inlet and cavity obstructing labor have been fibrocystic tumors of the ovarian ligament, requiring an abdominal section ; fibroma of the ovary ; sarcoma of the ovary ; a displaced adherent kidney at the pelvic inlet, necessitating version and forcible extraction, or possibly, as was done suc-

cessfully by Cragin, vaginal section and removal of the tumor;[1] hydatid cysts of the pelvis, demanding Cesarean section;[2] a displaced and enlarged spleen; masses of exudate, caseous lymph glands, and an aneurysm of the gluteal artery.

A cystocele and a rectocele should be replaced if they protrude to a great extent in front of the head, and should be held back until a forceps is applied and the head is pulled past them (Fig. 428). Version and extraction have occasionally been found necessary. Large fecal masses in the rectum must be removed by an enema or must be dug out.[3] Calculi in the bladder should, if possible, be discovered and removed by the urethra or by vaginal lithotomy before the second stage of labor. They may become nipped between the head and the pubic bones, and may pinch a hole through the anterior vaginal wall and bladder if they are overlooked or neglected.[4] The diagnosis of vesical calculus in the parturient woman is difficult: it has been taken for a pelvic exostosis or some other pelvic tumor, and in one case at least Cesarean section was performed on account of this mistake. Fortunately, vesical calculus in the female is rare. In 10,000 women examined by Winckel in fifteen years, it was found only once.

The following conditions in and about the rectum may present mechanical obstacles to delivery: Cancer, anus vestibularis or vaginalis, foreign bodies, contraction of the levator ani muscles, benignant tumors, such as cysts of the rectum, ovarian cysts which have perforated the rectum, and retrorectal dermoid cysts. Each of these conditions must be treated according to the individual indications. Incisions in the perineum may be required, foreign bodies must be removed, resisting muscles on the pelvic floor may be overcome by an anesthetic and by the application of forceps, and cystic tumors should be punctured or removed after ligation of their pedicles. Cancer of the rectum may demand Cesarean section by reason of the size of the tumor and the cicatricial infiltration of the birth-canal, as in Freund's case.

[1] Runge reports four cases ("Archiv f. Gyn.," xli, p. 99). The writer has had one. Albers-Schoenberg reports another in which the uterus ruptured ("Centralblatt f. Gyn.," Dec. 1, 1894). Cragin has collected six cases including his own ("Am. Jour. of Obstet.," vol. xxxviii, p. 37).

[2] "Les Kystes Hydatiques du Bassin et de l'Abdomen au point de vue de la dystocie," J. Franta, "Ann. de Gyn. et d'Obstet.," Mar., 1902.

[3] Corradi reports a case in which seven pounds of hardened feces were removed before the woman was delivered.

[4] Kotschurowa has reported a case in which labor lasted three days. At the end of that time a gangrenous tumor protruded from the vulva, which proved to be the bladder and anterior vaginal wall. The midwife in attendance perforated the tumor with her finger, whereupon a calculus eighty-five grains in weight was discharged ("Jahresbericht ü. d. Fortschr. a. d. Gebiete der Geburtsh.," etc., vi, 225)

Obstruction in Labor on the Part of the Fetus.—Overgrowth of the Fetus.—Excessive overgrowth of the fetus is rare. In 1000 children in the Maternity Hospital of Philadelphia only one weighed more than 12 pounds. The largest child the author has ever seen weighed 15 pounds; weights of 15, 16, 18, 23½, and 28¾ pounds have been recorded. The causes of overgrowth in the fetus are prolongation of pregnancy, oversize and advanced age of one or both parents, and multiparity. Rarely, it may be inexplicable. The first named is, in the writer's experience, the most common cause. In six per cent. of women pregnancy may be expected to be prolonged beyond the three-hundredth day, and for every day that the fetus is retained in the womb beyond the usual time there is an increase in its size and weight above the normal. So much difficulty and danger may be experienced from this cause that it is a good rule in practice to allow no woman to exceed the normal duration of pregnancy by more than two weeks. By inducing labor at that time one occasionally interferes unnecessarily, but he often avoids complications and difficulties of the most serious nature.

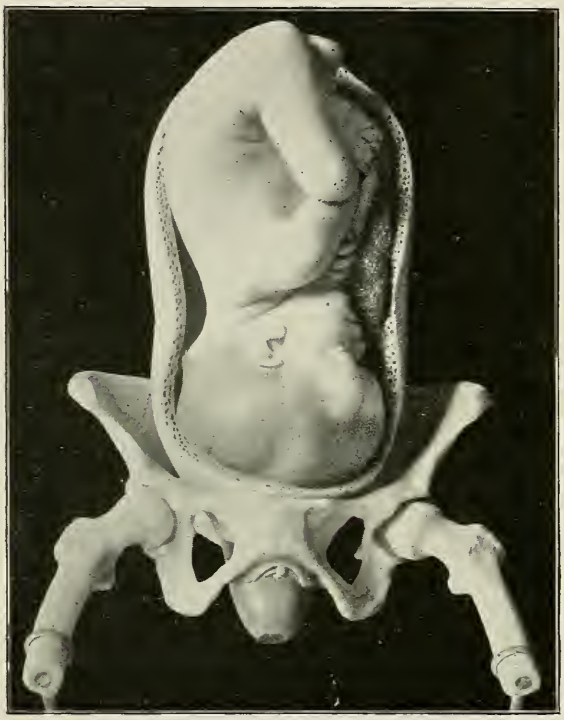


Fig. 429.—Overgrowth of head obstructing labor.

Oversize and advanced age of one or both parents may be a cause of overgrowth in the fetus—the latter usually because it predisposes to a prolongation of pregnancy. It is commonly asserted that the size of children increases in successive pregnancies up to the fourth or fifth, and then remains stationary or even decreases; but there are important exceptions to this rule. The

writer has seen the tenth child vastly exceed in size the nine preceding; it weighed 15 pounds, and it was necessary to deliver it by Cesarean section. The other children had been born naturally through a flat pelvis with a conjugate diameter of nine centi-

Fig. 430.—Dicephalus.

Fig. 431.—Dicephalus.

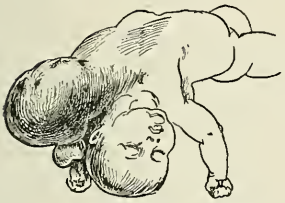


Fig. 432.—Lymphangioma.

Fig. 433.—Craniopagus.

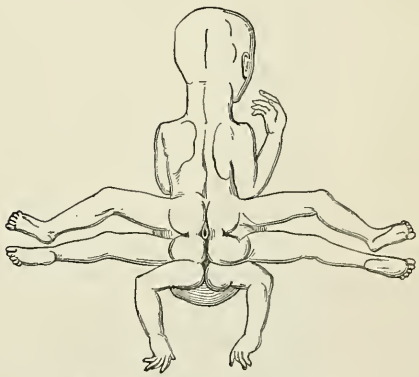


Fig. 434.—Ischiopagus parasiticus.

meters. The increase in size of successive children must be borne in mind in cases of contracted pelvis. The first two or three infants may be delivered spontaneously, but the larger size of the fourth or fifth may make natural delivery impossible.[1]

Overgrowth of the fetus is the most difficult condition in obstetric practice to diagnosticate with precision. A careful palpation of the head and body and an attempt to push the former

[1] Lehmann in 712 labors through 198 contracted pelves found increasing difficulty in delivery with each succeeding labor. In first labors 50 per cent. ended spontaneously; in second, 43.8; in fourth, 38.4; in fifth, 33⅓; and in labors after the fifth only 9.8 per cent. ("Diss. Inaug.," Berlin, 1891).

Fig. 435.—Prosopothoracopagus.

Fig. 436.—Xiphopagus.

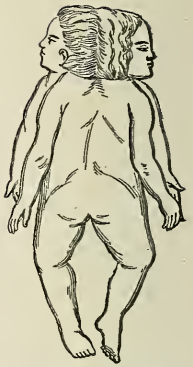


Fig. 437.—Janiceps.

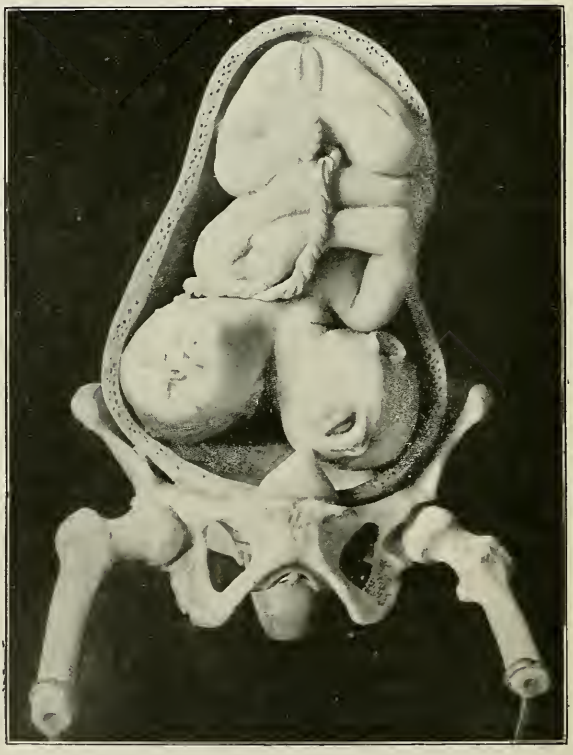


Fig. 438.—Dicephalus: neither head engaged.

into the pelvic inlet may give one an approximate idea of the relative size of fetal body and pelvic canal, and the methods of antepartum fetometry already described may enable the physician

Fig. 439.—Hydrencephalocele (anterior).

Fig. 440.—Sacral teratoma obstructing labor.

to estimate the size of the fetal head accurately, but, as a matter of fact, the large size of the fetus is usually discovered in practice only after prolonged delay when attempts at artificial delivery especially by version, have failed. By this time the fetus is commonly dead, and should be delivered by embryotomy. But the practitioner must be on his guard against futile attempts to deliver an infant too large, even when mutilated, to pass through the pelvis. The writer has seen, in consultation practice, several maternal deaths due to this cause.

Premature Ossification of Cranium; Wormian Bones;[1] *Large Heads; Malformations and Tumors of the Fetus.*—No single rule

Fig. 441.—Myxoma of neck (Longaker).

Fig. 442.—Sacral tumor (Mütter Museum, College of Physicians).

of treatment can be laid down for the management of these cases. Forceps, version, or some form of embryotomy is usually demanded. Spontaneous labor, however, is possible even in cases of monstrous bulk in which delivery through the birth-canal would seem out of the question. Thus, in double monsters joined loosely by the front or back (xiphopagus, the Siamese twins; pygopagus, the Hungarian sisters), one child may be born by the head, the other afterward by the breech, or vice versâ. In dicephali one head may be pressed into the neck of the other or may rest upon the iliac bone of the mother until the first head makes its escape from the vulva. Even in thoracopagus, the commonest double monstrosity, in which two trunks are intimately joined front to front, spontaneous labor is possible by the mechanism shown in figure 445. On the other hand, the

[1] Dr. Grace Peckam ("New York Med. Record," April 14, 1888) has reported three still-births, attributed in each instance to the development of Wormian bones in the smaller fontanel, and to the consequent interference with overlapping of the cranial bones at the sutures. This observation has not yet been verified by others.

greatest difficulty may be encountered in labor, and a Cesarean section may be necessary.[1]

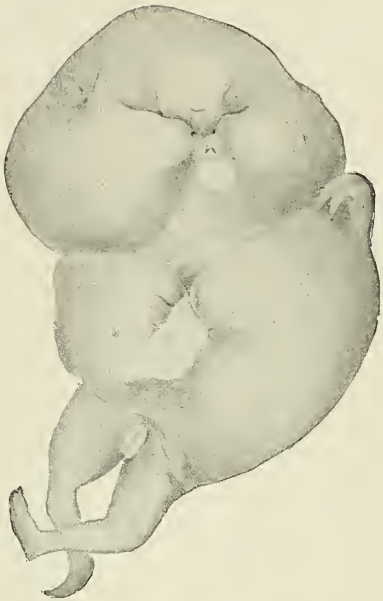


Fig. 443.—Anasarca.

Fig. 444.—Mechanism of labor with dicephalus (Küstner).

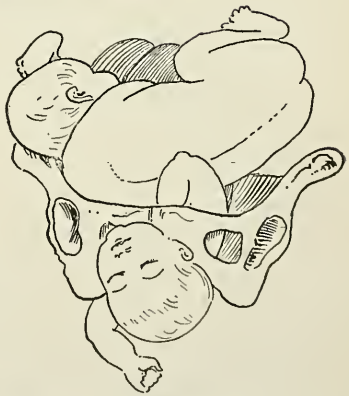


Fig. 445.—Mechanism of labor in thoracopagus (Küstner).

Fetal tumors obstructing delivery may be hydrencephaloceles, lymphangiomata, myxomata, sacral teratomata. Cystic tumors should be punctured. Solid tumors may call for version or for

[1] There are two recorded deliveries of thoracopagi by Cesarean section (Hirst and Piersol, "Human Monstrosities").

embryotomy. In a case of sacral teratoma, the child presenting by the umbilicus, the author found it necessary to eviscerate the infant before it could be extracted. The tumor has been amputated, embryotomy and version have been performed. The tumor not infrequently ruptures and often the labor is easy because the fetus is premature.[1] Craniotomy may be required in monstrous enlargement of the cephalic extremity, as in syncephalus or in diprosopus. Decapitation may be necessary in duplicity of the cephalic extremity, as in dicephalus or in thoracopagus. In Reina's case of tricephalus the first head was perforated and then amputated, the second was perforated, crushed, and amputated, and the third was amputated.

Diseases and Death of the Fetus.—All diseases of the fetus that increase its bulk may obstruct labor. Cystic tumors, effusions in the serous cavities, anasarca, an enlarged liver, polycystic disease of the kidneys,[2] and distended bladder from atresia of the urethra[3] are examples. Liquid accumulations should be evacuated by puncture or by incisions.

Hydrocephalus is the most important of the diseases increasing fetal bulk. It is not very rare,[4] is often overlooked, and is a frequent cause of ruptured uterus. The *diagnosis* may be made by a vaginal examination, by abdominal palpation, and by a combined examination, or, if necessary, by anesthetizing the woman, introducing the whole hand into the vagina, and thoroughly palpating the enlarged head resting above the pelvic brim. The gaping fontanel, the great width of the sutures, the fluctuation within the cranium, the large size of the head appreciated by bimanual examination, and possibly the abnormal mobility of the cranial bones, and in some cases their extreme tenuity, indicate the condition. Hydrocephalus is very often overlooked in practice as the result usually of a careless, superficial examination. A painstaking and methodical investigation of a suspected case should obviate this error. There are cases, however, in which there is no increased width of the sutures, no enlargement of the fontanels, and such slight enlargement of the head that it can not be appreciated; and yet the fluid contents of the cranium prevent compression of the skull and make the engagement of the

[1] For interesting statistics of this condition see Uthmöller, "Ueber Geburten bei steisstumoren," "Monatschr. f. Geb. u Gyn.," Dec., 1903. Of the collected cases 126 have been girls, 60 boys. The frequency is reckoned at 1–34, 582 births.

[2] Fussell, "Med. News," Philadelphia, 1891, p. 40.

[3] Schwyzer ("Archiv f. Gyn.," Bd. xliii) has collected 13 cases of dilatation of the fetal bladder from atresia of the urethra, stenosis of the urethra, and obstruction of the urethra by a valve-like formation of mucous membrane. Müller reports a case and quotes another ("Archiv f. Gyn." Bd. xlvii, H. 1).

[4] Schuchard found it sixteen times in 12,055 births; Lachapelle and Dugés, fifteen times in 43,555; Merriman, once in 900. In 159 cases there were 38 maternal deaths, 20 of which were from rupture of the uterus.

head impossible. The writer has seen such cases (see Fig. 446). Hydrocephalus should always be suspected if the head in labor remains above the brim, although the pelvis is normal in size and no good reason can be found for the failure of engagement.

The treatment of labor obstructed by hydrocephalus is puncture of the cranium with a perforator and evacuation of its fluid contents. A child with this disease deserves no consideration. After the reduction in the size of the head the labor may be left to the natural forces. If these prove insufficient, a cranioclast may be fastened to the skull and the child be extracted artificially. A cardinal rule in the treatment of these cases is to avoid attempts to deliver with forceps—a common error in practice, and one that has cost many a woman her life from ruptured uterus,

Fig. 446.—Hydrocephalus: very moderate distention of the cranium, but sufficient to prove an insuperable obstacle in labor.

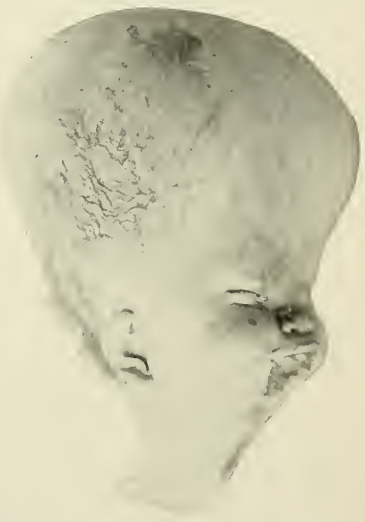


Fig. 447.—Hydrocephalus: enormous collection of fluid (author's collection: specimen presented by Dr. Alex. Fulton).

from deep tears when the instrument slips, as it will, and from extensive sloughs after delivery.

If the pelvic extremity of the hydrocephalic fetus presents,—as it does in almost a third of all cases,—and if the head remains inaccessible above the superior strait, so that it can not easily be punctured, the spinal canal may be opened, a catheter be passed

through it into the cranial cavity (Van Huevel's method), and the fluid thus be evacuated (Fig. 448). Usually, however, there is no special difficulty or danger in the delivery of the after-coming head of a hydrocephalic infant. The force required for its extraction not infrequently ruptures the walls of the ventricles and converts the case into one of external hydrocephalus, or possibly drives the fluid out of the foramen magnum into the tissues of the neck and back, so reducing the bulk of the head as to permit its extraction. At any rate, the condition can

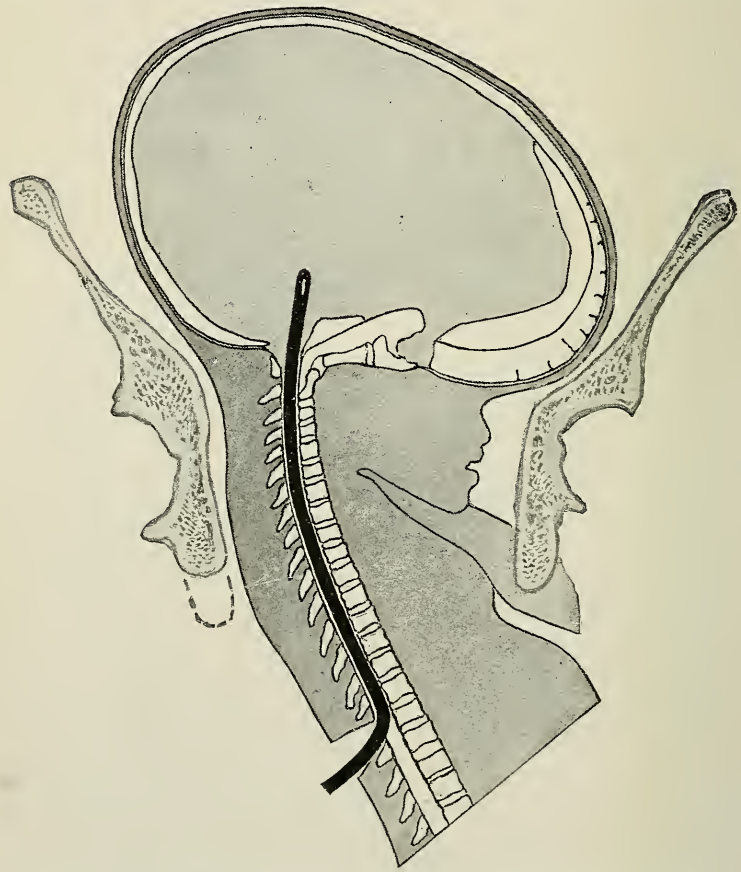


Fig. 448.—Tapping a hydrocephalus through the spinal canal (Varnier).

scarcely escape the notice of the medical attendant, and a diagnosis is made before the lower uterine segment is dangerously stretched or ruptured. The head may be punctured through the roof of the mouth, through the foramen magnum, or behind the ear.

The difficulty in the delivery of a hydrocephalic fetus is not in direct proportion to the quantity of fluid in the ventricles and the size of the head. In cases of extreme distention, the cranial vault is likely to rupture, while in moderate grades of hydrocephalus the quantity of brain-substance surrounding the ventricles and the strength of the brain-membranes forbid this means of spontaneous delivery.

Malpresentations and faulty positions include shoulder, face, brow, deviated vertex, and compound presentations. All but

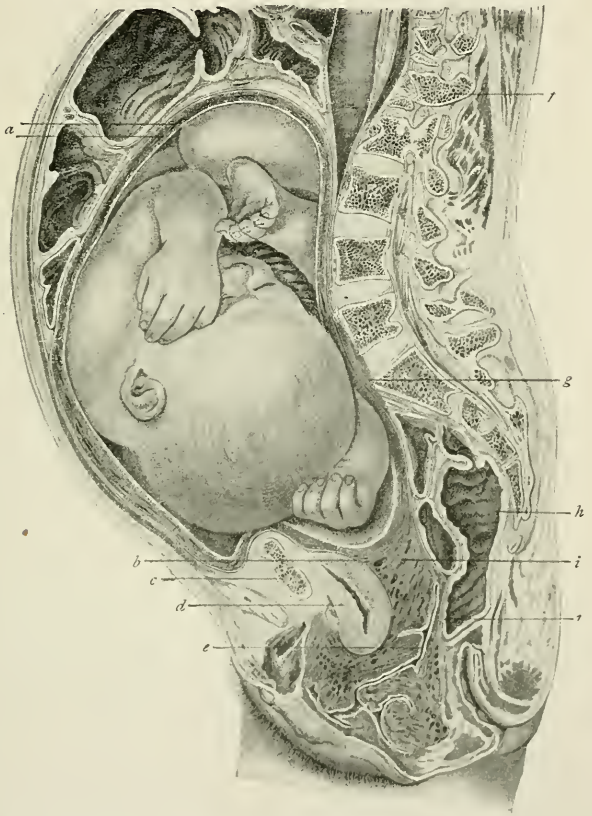


Fig. 449.—Compound presentation: head and hand. Braun's section of a multipara who committed suicide by hanging in the last month of pregnancy: *a*, Venous sinuses; *b*, uterovesical reflection of peritoneum; *c*, symphysis pubis; *d*, bladder; *e*, vagina; *f*, first lumbar vertebra; *g*, promontory of sacrum; *h*, rectum; *i*, cervix; *j*, pouch of Douglas.

the last are considered elsewhere. By compound presentation is meant the presentation of two or more parts at the same time, as a head and a hand, a head and a foot, a hand and a foot,

nuchal position of the arm, or the head and all four extremities.

A compound presentation is met with about once in 250 labors. It is usually a head and a hand. The following table is furnished by Pernice from 2891 births in the clinic at Halle:

Hand and head,	26
Arm and head,	8
Hand and umbilical cord,	5
Both hands,	4
Foot and hand,	2
Two hands, umbilical cord, and foot,	1
Face, hand, and cord,	1

Kietz found in 7555 labors the foot and head presenting in 23.[1]

The cause of compound presentations is usually a lack of

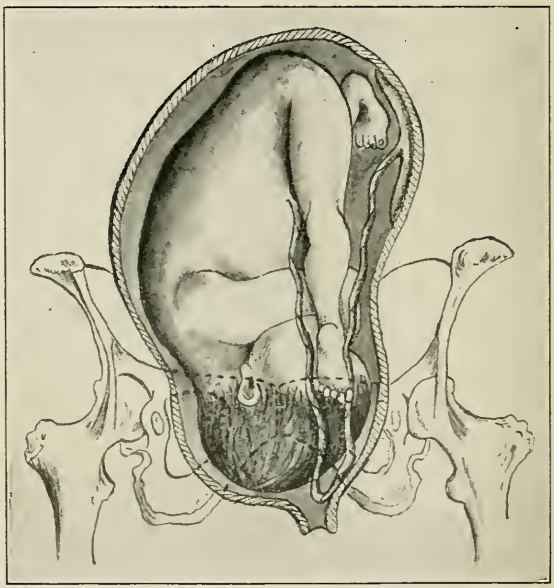


Fig. 450.—Compound presentation: head and foot (Author's case).

conformity in the presenting part with the pelvic inlet, as in malposition of the fetus, a head of abnormal size, a displaced uterus, twins, hydramnios, contracted pelvis, and anomalous shape of the uterus.

In the *treatment* of compound presentations before rupture of the membranes an attempt should be made to overcome the difficulty by postural treatment. The woman should be placed on that side opposite the prolapsed extremity. After rupture of

[1] "Diss. Inaug.," Berlin, 1890.

the membranes an attempt should be made to dislodge the prolapsed extremity and to restore it to its natural position. Version may, however, be required if this attempt fails, or even craniotomy if the child is dead. If the head and extremities present, and if the former is engaged, it is usually best to apply forceps and to disregard the prolapsed extremities. In the case of nuchal position of the arm, an effort should be made to dislodge the latter, but it may be necessary to fracture it before the delivery of the child can be secured.

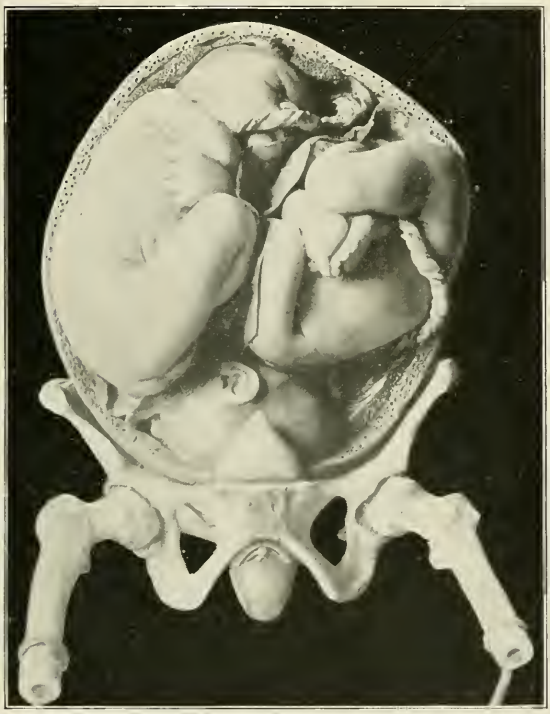


Fig. 451.—Twins; breech and face presentations.

Multiple Births.—Twin labors are usually easy and uncomplicated (75 per cent.), but complications are more frequent than in single labors. Malpresentations are common. The following table from Spiegelberg, based on 1138 labors, gives the combined presentations in the order of their frequency:

Both heads presenting,	49	per cent.
Head and breech,	31.70	" "
Both pelvic presentations,	8.60	" "
Head and transverse,	6.18	" "
Breech and transverse,	4.14	" "
Both transverse,	.35	" "

It may be noted that a transverse position is found in 10.67 per cent. of cases. Mechanical difficulties in labor are frequent: the uterine muscle is usually weakened by overstretching, and there may be trouble in the third stage of labor in the delivery of the placenta. Some form of operative interference is demanded in about 25 per cent. of all cases.

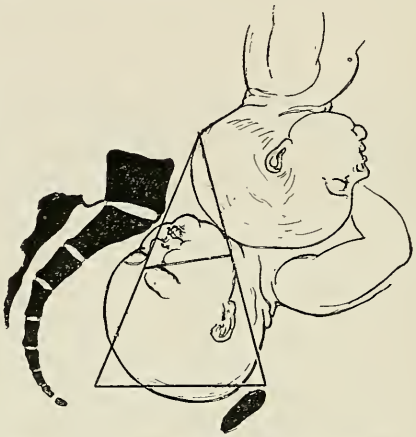


Fig. 452.—Impaction of heads in twin labor.

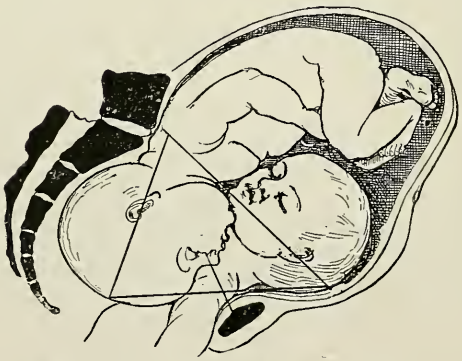


Fig. 453.—Locking of heads in twin labor.

In the majority of cases (79 per cent.) the interval between the delivery of twins is less than an hour.[1] A longer delay than this indicates the likelihood of some obstruction to the birth of the second infant or a failure of expulsive forces.

[1] In the "Semaine Med.," 1904, ii, 27, Paulin reports an interval of twenty-one days between the birth of twins. It was subsequently discovered that there was a uterus bicornis unicollis. This is probably the explanation of the cases occasionally reported of the birth of children weeks and even months apart.

Serious difficulty in twin labors may arise in one of three ways: Both heads present at once, one a little in advance of the other, the second impacted in the neck of the first (Fig. 452); the first child descends by the breech, and the head of the second child is caught by the chin of the first and pushed into the pelvis (Fig. 453); one child sits astride of the other, which is transverse. If both children should be found attempting to engage by the head in the superior strait at one time, one child should be retarded while the other is artificially extracted. If this is impossible, the first head should be extracted by forceps, the second be treated in like manner, and then the trunks should be delivered one after the other. Embryotomy is a last resort, but is scarcely ever necessary.

A coiling of the cords (Fig. 454) and their entanglement may be a source of difficulty and delay in unioval twins. It may be necessary to cut one or both cords between ligatures before the children can be delivered.

Fig. 454.—Entanglement of cords in twins (Winckel).

In case one child presents by the head and the other by the feet, both may come down together, and the two heads become locked in the pelvic entrance and canal. An effort may be made to push back the child presenting by the head. If this succeeds, the child presenting by the breech should be extracted immediately, for it is in imminent danger from asphyxia. It may be possible with forceps to pull the child presenting by the head past the body of its fellow presenting by the breech. Failing in these attempts, the child presenting by the breech will almost surely have died, and there will be no pulsation in its cord. It should then be decapitated, whereupon the infant presenting by the head can be extracted without difficulty by forceps.

In any case of twin labor, as soon as the first child is born, and the cord, ligated with a double ligature, is cut, the attendant should immediately investigate the position and presentation of the second child. A neglect of this rule leads very often to the impaction of an unrecognized shoulder presentation in the second child, and its consequent death. If an abnormality is discovered in the presentation of the second child, it should at once be cor-

rected. Then, after waiting perhaps half an hour, the amniotic sac should be ruptured, and ergot should be administered in a full dose to secure a speedy delivery, or, if the stomach will not retain it, ergotin should be given hypodermically, for, the birth-canal having been dilated thoroughly, there is no obstacle to the birth of the second infant in twin labors, and consequently no objection to the employment of ergot, which not only hastens the conclusion of labor, but promotes subsequent contraction of the much-distended uterus, and so prevents postpartum hemorrhage. As a further precaution against this accident which is always

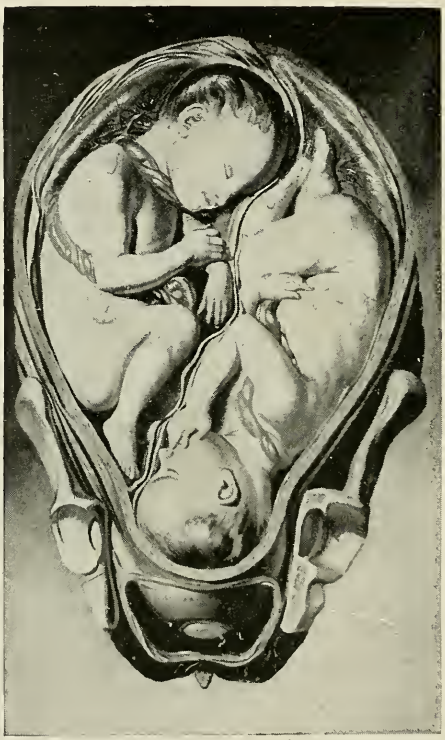


Fig. 455.—Twins, head and breech (modified from Hunter).

threatened in twin labors, the fundus should be kneaded and compressed by the nurse for an hour or two after birth.

There may be difficulty in the delivery of the placentæ in twin labors. Commonly the children are born first and the placentæ afterward. Their bulk may make expression difficult, and it is often necessary to make some traction upon the cords—first upon

one and then upon the other—to determine which placenta will come first and to assist in its expulsion. Occasionally one and rarely both placentæ may be expelled after the birth of the first child. In a case of the writer's the placenta of the first child, prolapsing in front of the second, necessitated a difficult forceps operation for the extraction of the second. On account of the frequent and extensive anastomoses between the vessels of the placentæ in unioval twins it is a necessary precaution to tie the cord of the first child with a double ligature and to cut it between the ligatures ; otherwise the second infant might bleed to death.

The *prognosis* of twin labors is always doubtful. There are so many possible dangers for both mother and children that multiple labors must be regarded as distinctly pathological. Albuminuria in the mother is the rule in multiple pregnancies, and eclampsia is ten times more frequent than in single births.[1] There is a disposition to inertia uteri during and after birth from distention of the cavity, and consequently a likelihood of post-partum hemorrhage. Some operative interference or intra-uterine manipulation is called for in about twenty-five per cent. of cases, and this, in addition to the frequency of kidney insufficiency, predisposes to sepsis. Finally, there may be insuperable obstruction in labor if locked twins are not managed properly, and the woman may die of ruptured uterus or of exhaustion. The maternal mortality in the Budapest Maternity was four times as great as in the single births, and Kleinwächter's statistics give a mortality of thirteen per cent. For the children there is greater danger than for the mother. Twin pregnancy is almost always prematurely interrupted, and even if it is not the children are, as a rule, under the normal size and weight. There is always the possibility that the development of one child at least will be seriously interfered with by the lack of room in the uterine cavity. Hydramnios of one sac and oligohydramnios of the other are not uncommon. In labor there are frequently complications from malposition, operative interference, entanglement of or pressure upon the cords, and more rarely the engagement of both bodies at once in the pelvic canal. In Kleinwächter's and Kézmárszky's statistics the fetal mortality was nearly forty per cent. Of thirty-eight children in cases of locked twins, only six survived,—a mortality of eighty-four per cent.

Cases are on record in which an extra-uterine fetus has obstructed the delivery of the intra-uterine twin. It has been necessary to make a vaginal incision through which the former was extracted before the latter could be born.

Death of the fetus during or before labor, followed by *rigor*

[1] Of 627 cases of eclampsia, 69 were multiple pregnancies (Winckel).

mortis, has proven a source of obstruction in labor by the rigidity of the child and the consequent interference with the normal mechanism of its delivery, especially of the shoulders and trunk.[1] Ankylosis of the large joints of the extremities may have the same effect to a less degree.

Labor Complicated by Abnormalities in the Fetal Appendages.—*Membranes.*—If the membranes are too thin, they may rupture prematurely, and thus give rise to what is called a "dry labor," in which the birth-canal must be dilated by the hard, unyielding presenting part instead of by the bag of waters. Such labors are longer and more painful than the average, and there is a greater likelihood of lacerations in the cervix and a more frequent demand for an artificial termination with forceps. If the membranes are too thick, they rupture late, being preserved perhaps until the child's head presents at the vulvar orifice, or even until the complete escape of the head from the mother's body. In these cases the head and face are covered by the membranes as though by a veil, and care must be taken to free the mouth and nose quickly, that respiration may be instituted without interference. The membranes thus covering the head and face are spoken of as a "caul." It is possible for the whole ovum to be extruded unbroken at term. The writer has seen this occur as late as the seventh month, and it is actually recorded at the full period of gestation.

Difficulties in labor may be encountered in consequence of an abnormality in the quantity of liquor amnii. If there is too little, the labor has the same clinical features as though there had been a premature rupture of the membranes. If there is too much liquor amnii, there may be inertia as the result of overstretching of the uterine muscle-fibers.

Umbilical Cord.—If the umbilical cord is too short, it may cause premature detachment of the placenta or may prevent the advance of the child. The *diagnosis* of a short cord in labor is always difficult. It may be suspected, however, if there is exaggerated pain at the placental site, marked recession of the head after each pain, and an obvious retardation of labor without other ascertainable cause. Forceps should be applied in such a case if the presentation is cephalic. If the cord is too long, it may possibly prolapse should there be other conditions in the labor favorable to such an accident; or it may be coiled about the child's neck, trunk, or extremities, and may consequently be fatally compressed during labor (Fig. 456).

Obstruction of a mechanical character in labor on the part of

[1] Feis, "Ueber intrauterine Leichenstarre," "Archiv für Gynäkologie," Bd. xlvi, H. 2.

the placenta is seen only in placenta prævia and in prolapse of the placenta. The placenta may be adherent as the result of syphilitic or other inflammation of the endometrium during pregnancy, and, becoming partially detached in the third stage, may cause alarming hemorrhage. It is often simply retained in the lower

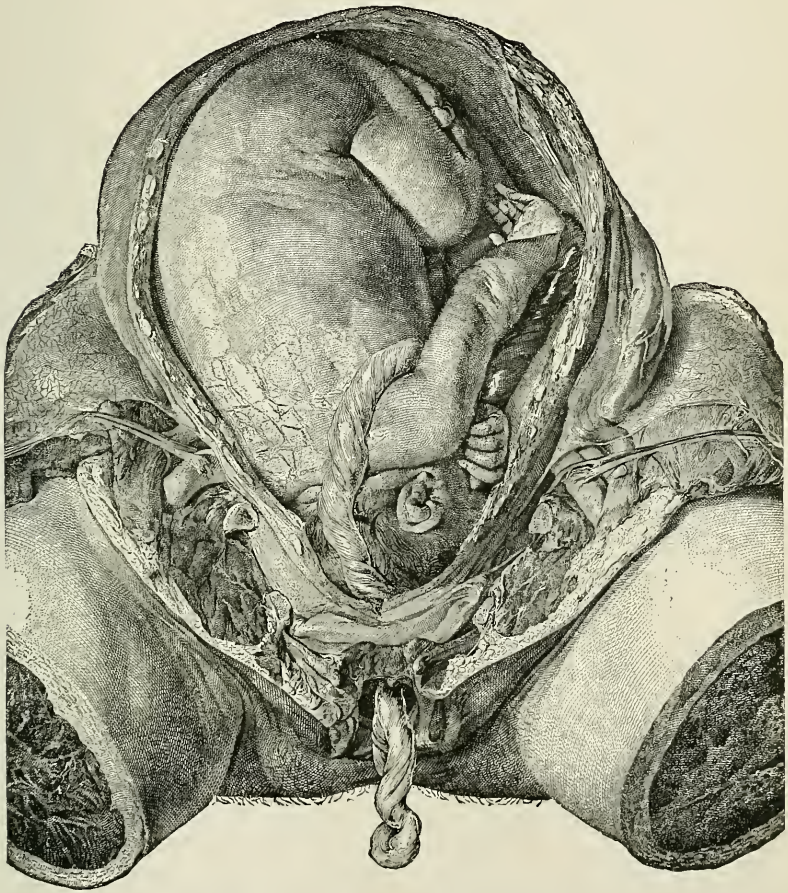


Fig. 456.—Placenta prævia: umbilical cord, caught in the axilla, encircling the shoulder and prolapsed (Hunter).

uterine segment or in the vagina, whence it may be expressed by the proper application of Credé's method. In some cases atmospheric pressure obstructs the delivery of a retained placenta so effectually that it is necessary to hook one's finger over the edge of it, to allow the access of air behind it, before its expression is possible. Retention of the placenta may be due to its great bulk,

as in twin placentæ, or to tumors increasing in size. In such cases it may be necessary to extract the placenta manually.

LABOR COMPLICATED BY ACCIDENTS AND DISEASES.

Hemorrhage.—One of the gravest and, unfortunately, one of the commonest accidents during and directly after labor is hemorrhage. The causes of hemorrhage during the first and second stages of labor are placenta prævia, premature separation of a normally situated placenta, rupture of the uterus, lacerations along the lower birth-canal, and rupture of a blood-vessel or of a hematoma. The causes of hemorrhage during the third stage of labor and directly afterward are relaxation of the uterus, lacerations of the birth-canal, rupture of blood-vessels or of hematomata.

Placenta Prævia.—By placenta prævia is meant the attachment of the placenta to the lower uterine segment. In some varieties of the condition the placenta presents itself first to the examining finger, and may even emerge before or in front of the child; hence the name.

History.—Early writers (Guillemau and Mauriceau, 1609–1668) recognized placenta prævia, but they explained it as an accidental prolapse of the placenta. Portal (1685) described it more correctly, though indistinctly. Schaller (1709) demonstrated the condition in the dissection of a body. From Levret's time placenta prævia was well understood. Rigby (1789) defines it as the attachment of the placenta to that part of the womb which always dilates as labor advances—a definition that is strictly accurate to-day. It is to Rigby, too, that we owe the term "unavoidable hemorrhage" to describe the hemorrhage of placenta prævia, as opposed to the "accidental hemorrhage" from premature detachment of a normally situated placenta.

Frequency.—Placenta prævia varies in the frequency of its occurrence in different localities and at different times, as the following table demonstrates:

Reporter.	Number of Labors.	Cases of Placenta Prævia.	Proportion.
C. V. Braun	7,853	15	1–522
Hugenberger	8,036	42	1–191
Lomer	6,862	136	1–50
Winckel (1873–78)	6,324	7	1–903
Winckel (1879–87)	8,500	30	1–283
Müller	876,432	813	1–1078
Lusk	1,550	0	0–0
Schwarz	519,328	332	1–1564
Midwives' report in Saxony (1878)	119.553	78	1–1532

The frequency of placenta prævia may be estimated at about 1 in 1200 labors. If the situation of the placenta were investi-

gated by a careful examination of the rent in the membranes after every labor, placenta prævia would be found quite fre-

Fig. 457.—Central placenta prævia, the os partly dilated (Hunter).

quently. In my experience it has occurred about once in 300 labors; but in only a quarter of the cases was the condition manifested before and during labor by its most characteristic symptom, hemorrhage.

Etiology.—A perfectly satisfactory explanation for the occurrence of placenta prævia has not yet been found. Clinical observation shows that any chronic inflammation or congestion of

the womb predisposes to it. Hence placenta prævia is three to six times more common in multiparæ than in primiparæ, and is more often met with in the working classes. Uterine myomata and carcinoma of the cervix are predisposing causes, on account, no doubt, of the endometritis that accompanies them. Ingelby reports two cases of abnormally low situation of the tubal orifices, in one of which placenta prævia occurred three times; in the other, ten. Multiple pregnancies, according to Winckel, furnish four times as many cases of placenta prævia as do single pregnancies, and a woman beginning to bear children late in life is liable to placenta prævia in subsequent pregnancies. Uterine malformations are apparently a predisposing cause. A case is reported by Schwarz of uterus bicornis in which placenta prævia recurred three times.

Hofmeier and Kaltenbach[1] furnish the best explanation for the abnormal situation of the placenta. These observers have demonstrated, by the examination of young ova, that the chorion villi in the lower pole of the ovum may develop in an hypertrophied decidua reflexa, thus carrying the placenta down to and across the internal os. At first an adhesion between the decidua vera and the reflexa is prevented by catarrhal discharge, but as the ovum develops the reflexa may adhere to the vera, thus fixing the placenta in its abnormal situation, permitting its continued growth, and giving rise to an apparent hypertrophy of the decidua serotina. Gottschalk's[2] observation of a young ovum imbedded at the edge of the internal os demonstrates that an abnormally low attachment of the ovum in the uterine cavity may be accountable for placenta prævia.

Varieties.—Four divisions are made of cases of placenta prævia —central, partial, marginal, and lateral. In the first the center of the placenta lies over the internal os; in the second the greater mass of the placenta lies upon one side of the lower uterine segment, usually the right (56 : 37, Müller), though the internal os is completely covered by it; in the third a margin of the placenta projects over the internal os; in the fourth the placenta is situated upon one side of the lower uterine segment and only the edge of it projects into the cervical canal, if it does so at all, when the os is fully dilated. This classification is justified upon clinical grounds. In central and partial placenta prævia the hemorrhage begins early in pregnancy, is profuse and frequently repeated, and in labor is more dangerous than is the hemorrhage of the lateral variety. There is an added difficulty, too, on account of the obstruction offered by the placenta, stretched across the internal os, to the spontaneous descent of the

[1] "Lehrbuch der Geburtshülfe."

[2] "Verhandl. d. deutsch. Gesellsch. f. Gynäk.," Bd. vii, 1897, S. 289.

child, or to the physician's efforts to reach and extract it. In lateral placenta prævia hemorrhage usually does not occur till labor is well advanced, and often does not appear at all. Lateral and marginal placenta prævia are the commonest varieties. In 270 cases the placenta was marginal and lateral 217 times; central and partial 53 times (Winckel). Strictly speaking, central placenta prævia is very rare. There is almost invariably more of the placenta on one side of the internal os.

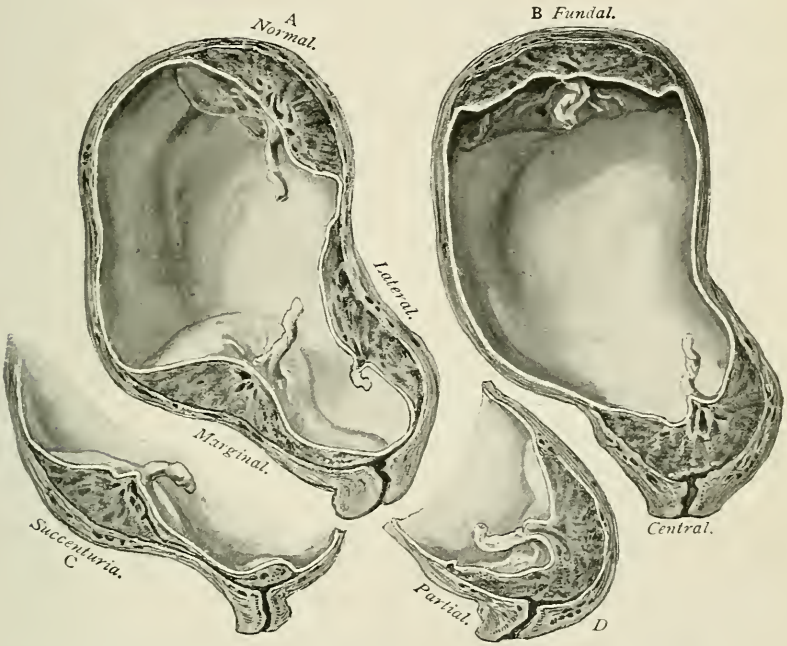


Fig. 458.—Varieties of placenta prævia: in A there are seen the normal, lateral, and marginal implantation; in B there are represented the implantation of the placenta at the fundus, which is rare, and implantation over the internal os; in C lateral implantation and that of a cotyledon immediately over the internal os; and in D partial implantation (Dickinson).

Clinical History.—A woman with placenta prævia may begin to bleed as early in pregnancy as the second month, but the first hemorrhage usually occurs in the last trimester. There is a sudden gush of blood, often without apparent cause and without pain. The bleeding commonly recurs in increasing amounts and at decreasing intervals as pregnancy advances. In very rare cases the blood leaks away continuously (stillicidium), though this is more characteristic of the premature separation of a normally situated placenta. The cause of the hemorrhage during pregnancy is the impact of the embryo and fetus upon the placenta,

the pressure of the ovum upon the lower uterine segment, and the imperfect attachment of the placenta in certain areas to the uterine wall. A prediction of the amount of bleeding in labor can not always be made by the amount of blood lost or the frequency of the hemorrhages in pregnancy. The first hemorrhage may occur in labor, which may be ushered in by a tremendous outpour of blood, even in lateral placenta prævia. Ordinarily, however, the greater the bleeding during pregnancy, the more likelihood is there of serious hemorrhage in labor. The bleeding in labor is easily explained. The placenta is attached in that portion of the uterine cavity which must be dilated to allow the advance of the presenting part. The stretching of the uterine walls expands the area of the placental site, and necessarily detaches the placenta, while the reversal of the ordinary mechanism of placental detachment keeps the gaping mouths of the torn uteroplacental vessels wide open, and allows the blood to pour from them till the hemorrhage is checked by syncope, by thrombosis, by the pressure of the presenting part, or by a vaginal tampon. The source of the bleeding in rare cases is a rupture of the circular sinus of the placenta, a laceration of the fetal vessels or of the cervix.

The bleeding is usually most profuse just as the uterine contraction passes off. During the height of the pains it may cease altogether, from the pressure of the presenting part or of the intra-uterine contents upon the placental site.

As the placenta occupies a portion of the space in the lower uterine segment and may prevent the descent of the presenting part, abnormalities in the presentation and position of the fetus are common. Transverse and oblique positions are ten times, breech presentations four times, more frequent than in normal labors.

In the first stage of labor, inertia uteri is common, partly because the cervix is not pressed upon and reflex irritation is absent, partly on account of the loss of blood.

The os is usually patulous, even before labor begins, and the cervical canal is easily dilated. Occasionally, however (twelve per cent.), the os is contracted and the cervix rigid.

The insertion of the cord is often marginal or velamentous, and prolapse of the cord is common.

The placenta is often anomalous in shape, size, thickness, and weight. There is frequently a placenta succenturiata. As the os dilates the placenta may be torn and thus separated into two parts. An adherent placenta may be expected in more than a third of the cases (Müller, thirty-nine per cent.).

After labor there is a tendency to inertia, and consequently to postpartum hemorrhage, and there is an extraordinary liability to septic infection.

Placenta prævia, as a complication in labor, would be much more common than it is if it did not so often interrupt pregnancy. The frequency of abortion and miscarriage is placed in different statistics at forty to sixty per cent.

In quite a large proportion of cases placenta prævia would be unrecognized in labor without a careful examination of the membranes and placenta afterward. Even in the marginal variety the presenting part, unobstructed, may descend quickly, exerting such pressure upon the placental site that bleeding does not occur.

Symptoms and Diagnosis.—Repeated hemorrhages during the latter part of pregnancy make the diagnosis of placenta prævia almost certain. On digital examination the cervix is found enlarged in all directions; the vaginal vault is soft and boggy; the presenting part can not be plainly felt; pulsating vessels are detected around the cervix; the external os is dilated and the cervical canal is patulous to the internal os, through which a finger can easily be pushed. Under favorable conditions the placenta may be felt through the abdominal walls, as was first pointed out by Spencer. Finally the maternal face of the placenta or its margin is felt over the internal os, the uneven surface of the cotyledons and a gritty feel distinguishing it from a blood-clot, the membranes, or the presenting part.

During the first stage of labor the causes of hemorrhage are lacerations of the birth-canal, rupture of blood-vessels, and placenta prævia. The hemorrhage of placenta prævia occurs early, with unruptured membranes, with feeble pains or in their absence altogether, and the symptoms of uterine rupture and of lacerations along the lower birth-canal are absent. In the rare event of a ruptured blood-vessel along the lower birth-canal, the blood does not flow from the uterine cavity.

Treatment.—If a placenta prævia is detected during pregnancy, gestation should be terminated at the end of the seventh month, or at any time thereafter that the diagnosis is established. The hemorrhage before the thirty-second week is scarcely ever dangerous,[1] though in one case I was obliged to induce abortion before the fifth month on account of a loss of blood that was almost incessant. After the seventh month the woman may bleed to death at any time before medical aid can reach her. The induction of labor and its conduct should be as follows: Send for an assistant to administer an anesthetic; place the woman in the lithotomy position, with her knees supported by nurses or attendants; cleanse both hands and arms as for a surgical operation and put on sterile rubber gloves; wash the vulva and the vagina with tincture of green soap and hot water

[1] In the 128 deaths of Müller's statistics there was not one before the seventh month.

Fig. 459.—One leg has been drawn down, so that the os is tamponed and the placenta directly compressed by the hips of the child (Müller).

by means of pledgets of cotton; give a vaginal douche of bichlorid of mercury 1:4000; dilate the cervix by inserting first one finger, then a second, and next the thumb of the right hand; search on the

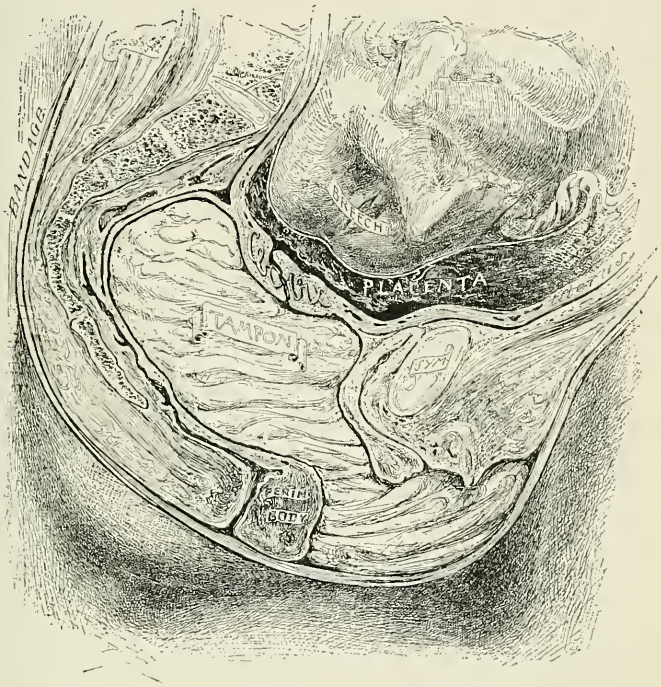


Fig. 460.—Placenta prævia: vagina tamponed with gauze (Dickinson).

woman's left side for the edge of the placenta; pass two fingers beyond it; perform bipolar version, assisted by the left hand externally; rupture the membranes; seize a foot and extract it until the knee appears at the vulva; then withdraw the anesthetic. If the bleeding has been alarming up to this time, it will cease as soon as the child's breech is impacted in the pelvic canal. From time to time the protruding leg may be gently pulled upon to hasten the dilatation of the cervical canal, but plenty of time must be allowed for it; otherwise the head is caught by the circular fibers of the cervix and the child is asphyxiated by the pressure upon the cord. At the expiration of an hour or more the child may be safely extracted. If the operator finds a rigid cervix and experiences great difficulty in its manual dilatation, he may employ Voorhees' bags; but under anesthesia, and with a fair amount of strength in one's fingers, hydrostatic dilatation is scarcely ever required. Instrumental dilatation (Bossi's dilator) is not recom-

mended, as the hemorrhage would be more profuse than it is with the pressure of the hand or a bag in the lower uterine segment which partially controls it, and the deep lacerations of the cervix caused by rapid instrumental dilatation add to the bleeding. If a physician discovers placenta prævia for the first time in labor by a profuse outpour of blood when the dilatation of the cervical canal begins, he should immediately pack the vagina as full as it can possibly be packed. The best material for this purpose is iodoform or sterile gauze if it is at hand, but a clean towel torn into strips will answer. The tampon serves the double purpose of controlling the hemorrhage and assisting the dilatation of the os. After a delay of

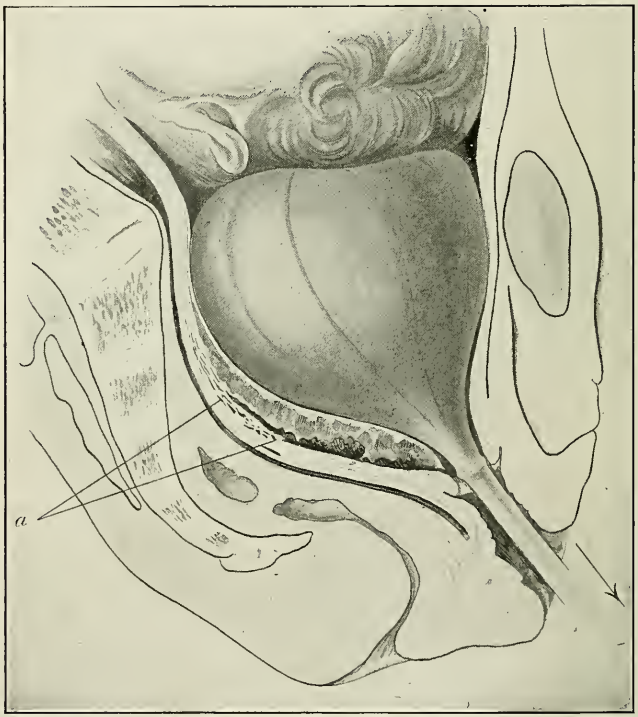


Fig. 461.—Braun's colpeurynter used as a metreurynter in placenta prævia: *a*, bleeding utero-placental vessels (Bumm).

an hour or two to allow time for the os to dilate, the patient is anesthetized and the operator proceeds as before described. If there is great difficulty in finding the margin of the placenta and the membranes beyond it, too much time should not be lost in the search. The placenta should be perforated and the child's leg pulled through the perforation. If the operator distrusts his ability to perform the version as quickly as it should be done (for

the hemorrhage is likely to be furious during the attempt), he may adopt a plan of treatment proposed by Wigand at the end of the eighteenth century. This consists in tamponing the vagina firmly and allowing the tampon to remain in place till the os is fully dilated. If the labor lasts too long, the tampon must be removed, the vagina douched, and a fresh tampon inserted. It is well to unite with the tampon treatment the procedure recommended by Barnes—separating the placenta by a sweep of the fingers around and beyond the internal os. This plan was suggested by the clinical observation that when the placenta separated and the presenting part descended the hemorrhage ceased. The combination of the Barnes and the Wigand treatment gives fairly good results for the mother, though it increases the risk of the sepsis. For the child it would seem to be bad, but we have testimony from Wigand, Murphy, and Winckel to the contrary. The fetal mortality is 48.5 per cent. (Winckel). In cases of marginal placenta prævia in which hemorrhage first occurs after the os is fairly well dilated, in which the head presents and is easily accessible, the best treatment is rupture of the membranes, application of forceps, and traction upon the head till the bleeding ceases; whereupon the instrument may be removed and the labor is allowed to terminate spontaneously.

The use of a dilatable rubber bag[1] (Braun's colpeurynter or Voorhees' bags) in the lower uterine segment (Fig. 461) should be considered in cases of lateral and marginal placenta prævia. It is inserted collapsed and sterile (boiled) through a cervical canal admitting one or two fingers; it is distended with water by a Davidson or a piston syringe, the bag resting against the *fetal* surface of the placenta; it is usually necessary to rupture the membranes alongside the edge of the placenta to place it properly; the tube attached to the bag is clamped with an artery forceps; from time to time traction is made upon it to hasten the dilatation of the os. As soon as the bag can be pulled through the cervical canal by moderate force it is removed; forceps is applied if the head is presenting, a foot is pulled down in breech presentations, or bipolar version is performed.

It may finally be necessary to detach an adherent placenta, to control a postpartum hemorrhage, and to treat the woman for acute anemia.

Cesarean section for placenta prævia, in the author's judgment, is not to be recommended. Its mortality in 25 cases has been 20.8 per cent. for the mother and 66.6 per cent. for the infants.[2] The maternal death-rate by version in the hands of experts is about

[1] See the excellent article, with good bibliography, by Dr. Lee, "Chicago Medical Recorder," 1901, p. 309, "The Use of the Colpeurynter in Obstetric Practice."

[2] Deaver, "Journ. Am. Med. Assoc.," April 30, 1904.

1 per cent., while the child has at least one chance out of two. Unless there is some reason more than ordinarily urgent for saving the latter at any cost, it does not seem right to subject the mother to an extra risk, such as would be involved in a Cesarean section performed by physicians in general. An expert might expect good results, but he would usually obtain the same by less radical

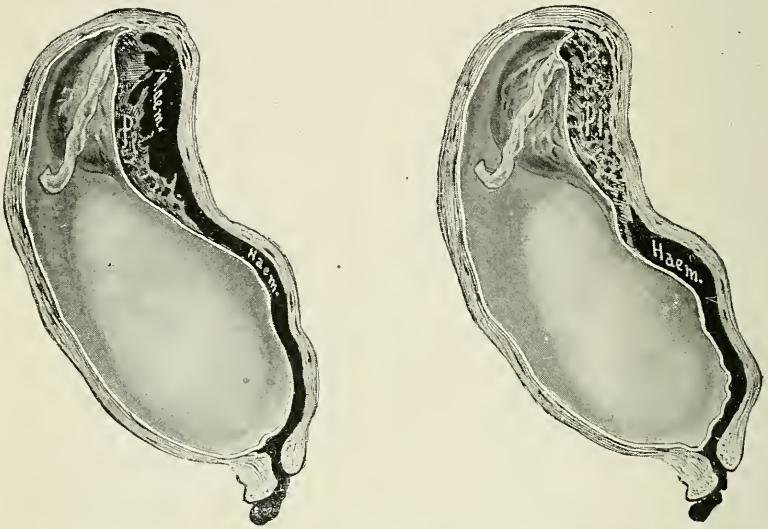


Fig. 462.—Showing separation of the placenta with external bleeding (Dickinson).

means. Occasionally, as in Webster's case of a thirteen-year-old girl with a narrow vagina and vulva, and in a case of the author's complicated by contracted pelvis and overgrown fetus, Cesarean section should be performed, but ordinarily version, the tampon or the metreurynter will give better results.

Prognosis.—The study of the mortuary statistics of placenta prævia is not very profitable. It appears that the maternal death-rate in general has been about 20 per cent., including the deaths from sepsis.[1] But with the plan of treatment just described, carried out by men who understand aseptic methods, the mortality almost disappears. Thus, Lomer (16), Hofmeier (37), Behm (35), and the writer (36) have had 116 cases, with 2 deaths (Hofmeier's and the author's). In 344 cases of placenta prævia in Schauta's clinic in Vienna from 1903–1905, treated by rupture of the membranes, dilatable bags, and combined version, the maternal mortality was 5.85 per cent., and in 274 cases in Zweifel's clinic the mortality was 8 per cent., making 618 cases, with a mortality

[1] Füth found in the district around Coblenz, in 726 cases, a death rate of 20 per cent. in general practice, "Zentralbl. f. Gyn.," p. 329, 1907.

of 6.92 per cent. For the children a mortality of 50 per cent. may be expected. The outlook for the child is worse the more nearly the placenta prævia is central.

Premature Detachment of a Normally Situated Placenta.—The placenta may become detached during pregnancy or before the third stage of labor, though it occupy a normal position near the fundus uteri. The necessary consequence is hemorrhage, often called "accidental," to distinguish it from the "unavoidable" hemorrhage of placenta prævia. If the lower margin of the placenta is detached, the blood separates the membranes from the uterine wall and escapes externally. The bleeding may, however, be entirely concealed (1) if the center of the placenta is alone detached; (2) if the upper margin is detached and the blood accumulates between the membranes and the uterine wall; (3) if the membranes are ruptured far from the internal os and the blood mingles with the liquor amnii; (4) if the cervix is obstructed by a blood-clot, the membranes, or the presenting part (Goodell). Concealed hemorrhage is, fortunately, rare.

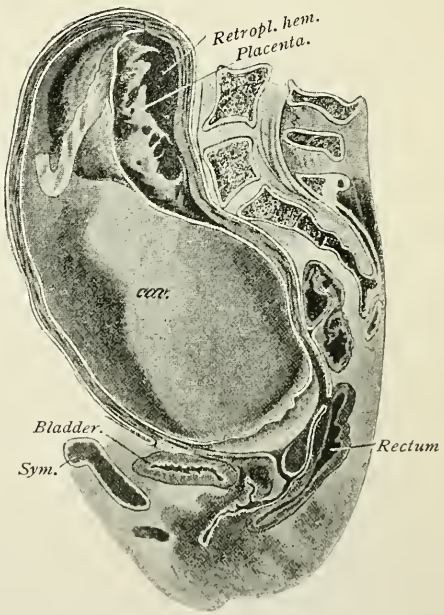


Fig. 463.—Premature detachment of the placenta occupying its normal site. Frozen section of an undelivered woman dead of eclampsia. A blood-mass under the placenta (after Winter).

Causes.—The cause of premature detachment of the placenta may be obscure. The accident may occur during sleep and without ascertainable cause. The causes are often, however, those of abortion: nephritis, congestion of the pelvis, external violence, physical effort, emotion. Prolongation of pregnancy, with irregular uterine contractions, was accountable for one of my cases. Death and disease of the fetus, hydramnios, a short umbilical cord, and multiple pregnancy may cause it. It occurs more frequently in multiparæ and toward the close of pregnancy.

Frequency.—Holmes [1] estimates the frequency at 1–200 preg-

[1] "Ablatio placentæ"; "Am. Jour. of Obstetrics," vol. xliv, 1901, a study of 200 reported cases; also, "Jour. Am. Med. Assoc.," p. 1845, 1908.

nancies, but in only 1–500 cases is the separation serious enough to demand attention.

Symptoms and Diagnosis.—Accidental hemorrhage, especially if concealed, should be recognized without delay. The accident usually occurs before labor begins or in the first stage. The uterine contractions usually become weak and finally cease, being replaced by persistent and severe pain, usually at the placental site, but occasionally the uterus is thrown into a tetanic contraction of the most violent character, associated with excruciating pain. There is shock, the signs of internal hemorrhage become more and more apparent, and the uterus is distended by the accumulation of blood within it. Feeble but persistent contraction of the upper part of the uterine muscle may be felt. If there is a retroplacental effusion, a localized bulging at the placental site may be made out by abdominal palpation.

The symptoms resemble somewhat those of rupture of the uterus. In both there are hemorrhage, shock, and perhaps sudden excruciating pain. But in rupture of the uterus the accident occurs late in labor, the membranes are broken, the presenting part recedes, the uterus is well contracted, and perhaps its contents are evacuated into the peritoneal cavity; while in accidental hemorrhage the detachment of the placenta occurs early in labor, the membranes are not ruptured, the presenting part does not recede, and in concealed hemorrhage the uterus is distended by the accumulated blood. In frank accidental hemorrhage the diagnosis rests between detachment of a normally situated placenta and placenta prævia. The presence or absence of the latter is determined by a careful internal examination.

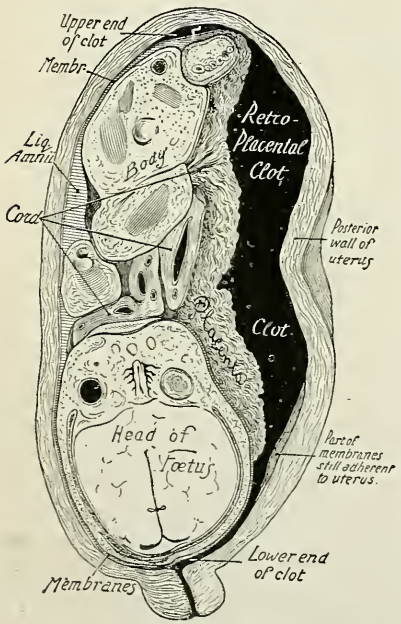


Fig. 464.—Accidental hemorrhage. Blood collected between placenta and part of membranes and the uterine wall (Pinard and Varnier).

In exceptional cases a frank accidental hemorrhage appears as early in pregnancy as the fourth month. Abortion usually follows, but I have seen two cases in which the bleeding continued uninterruptedly for

weeks, a large blood-clot formed between the site of the placental separation and the external os, and septic symptoms supervened. In spite of these unfavorable conditions pregnancy continued, and the fetus lived until I was obliged to terminate gestation on account of the anemia and the symptoms of systemic infection.

Prognosis.—The mortality in accidental hemorrhage is high. Goodell's statistics give 54 maternal deaths out of 107 cases, and of the 108 children (there being one case of twins) only 7 were saved. Holmes' statistics (*loc. cit.*) give a much lower mortality.

Treatment.—The main object of treatment is to evacuate the womb as speedily as possible, so that the uterine muscle may contract. At the same time it must be remembered that the woman is in no condition to endure much additional shock. The best procedure is to dilate the cervix with rubber bags or with the fingers, to perforate the membranes, and then to extract the child by the quickest plan available. If the presenting part is not engaged, the child should be rapidly extracted by the leg. If the head is engaged and a rapid forceps operation is practicable, the instrument should be employed. If not, craniotomy should be performed. Ergot should be administered hypodermatically, for postpartum hemorrhage is to be feared. A Cesarean section should be considered in the gravest cases, in which a continuance of hemorrhage and the shock of a forced delivery are more to be dreaded than abdominal section and puerperal hysterectomy.

Rupture of the circular sinus of the placenta may give rise to symptoms indistinguishable from those of premature detachment, and calling for the same treatment.[1]

Postpartum Hemorrhage.—Hemorrhage may occur during the third stage of labor, or in the first twenty-four hours of the puerperium, from relaxation of the uterine muscle, from injuries along the birth-canal, from ruptured vessels, tumors, malignant growths, or ulceration in the parturient tract.

Postpartum Hemorrhage from Relaxation of the Uterine Muscle.—When the placenta is separated from the uterine wall and the large maternal blood-vessels communicating with it are necessarily torn across, every woman after labor would bleed to death were it not for the following provisions on the part of nature to prevent hemorrhage: Leukocytes begin to block the uterine sinuses in the latter weeks of pregnancy, and the excess of the fibrin-making elements in the blood of pregnant women, together with the sluggish blood-current in the sinuses, favor the formation of firm blood-clots in their orifices when they are torn; the uterine muscle contracts the moment the uterine cavity is emptied,

[1] Mynlieff has collected 30 cases, "Diss. Inaug., Amsterdam," refer. "Jahresbericht," vol. xii, 1899, p. 757.

so that the blood-channels running through the uterine walls are ligated throughout their whole length by the contracting muscle-fibers that encircle them; the quality of retraction in the uterine muscle maintains what is gained by contraction. It is to the last two actions mainly that a woman owes her immunity from hemorrhage after labor.

The causes of postpartum hemorrhage are, therefore, those which interfere with uterine contraction. They are: Systemic weakness from disease; unfavorable hygienic surroundings or anxiety; weakness in the uterine muscle-fibers themselves, as when they are undeveloped, fatigued, overstretched by hydramnios or twins, inactive by reason of surrounding inflammatory products, exhausted by many previous labors, or too suddenly called upon to contract by a rapid labor, especially if it is instrumental; anomalies in the innervation of the muscle-fibers; a mechanical obstacle to firm contraction, as a retained placenta or clots within the womb, old adhesions upon its peritoneal surface, or a tumor such as a uterine fibroma, an ovarian cyst, a distended bladder or rectum, that by its bulk keeps the womb distended or displaces it. Some sudden effort may displace the clots in the uterine sinuses and thus favor hemorrhage, as coughing, sneezing, sitting up in bed, or defecation. Heart and lung disease or arterial tension from any cause may produce a congestion of the womb that predisposes to postpartum hemorrhage.

Symptoms and Diagnosis.—There is no difficulty in recognizing postpartum hemorrhage when the blood soaks through the mattress and runs across the floor in a stream. The bleeding should be detected early, however, that it may be arrested at once. There is usually a sudden gush of blood, followed by the expulsion every few seconds of several ounces of liquid blood and clots. The uterus is relaxed and it is difficult to outline it through the abdominal wall. There is an absence of that firm, round, easily palpable tumor usually filling the hypogastrium, characteristic of a firmly contracted womb. The constitutional signs of hemorrhage become rapidly more and more evident. The face is blanched, the pulse is quick and feeble, vision fails, there is air-hunger, and the woman, to satisfy her instinctive craving for more oxygen in the rapidly emptying blood-vessels, makes a curious sound between that of a gape and a sigh. Finally, there are restlessness, jactitation, convulsions, coma, and death.

In exceptional cases one tremendous outpour of blood, lasting not more than five minutes, kills the patient. One can not always judge the extent of the hemorrhage by the amount of blood that escapes externally. The dilated womb may contain enough within its cavity to cost the woman her life.

Very rarely, indeed, an uncontrollable postpartum hemorrhage is seen from a firmly contracted and an uninjured uterus. It occurred once from a ruptured aneurysmal vessel; again in connection with nephritis, presumably from atheromatous or diseased vessels; in one case from a ruptured hematoma of the cervix; in another from ulceration of the cervix that opened the uterine artery; in another from a ruptured varicose vein in the cervix. Cases have been reported of paralysis of the placental site, with firm contraction of the remainder of the womb.[1]

In high altitudes postpartum hemorrhage is said to be much more common than at lower levels, from the lessened atmospheric pressure. I have been told, by physicians practising in the high regions bordering upon the Rocky Mountains and in South Africa, that they have this complication to contend with very frequently.

Treatment.—Postpartum hemorrhage may occur after any labor. Measures to prevent it consequently form part of the routine management of labor, as already described. If any of the predisposing causes of uterine relaxation exist during labor, additional precautions should be taken. As soon as the presenting part emerges from the vulva, ergotin should be injected into the woman's thigh, the placenta should be expressed without too much delay, and the womb should be kneaded and compressed more vigorously and for a longer time than usual, until it remains firmly contracted and shows no disposition to relax. Then a large abdominal pad should be laid above the umbilicus and a firm abdominal binder should be adjusted. The nurse should receive instructions to watch the patient's appearance closely, to count the pulse frequently, and occasionally to turn down the bedclothes and observe the quantity of the discharge.

Should hemorrhage occur in spite of these precautions, it must be controlled with the least possible delay, for so much blood is lost in a short time that the woman may die of acute anemia, even though the bleeding be finally checked.

The beginner will do well to bear in mind the following plan of action that he may put it into immediate effect, without depending too much upon his presence of mind, readiness of resource, or self-command—qualities that perhaps are lacking when he is first confronted with one of the most alarming accidents of obstetric practice:

Seize the fundus uteri with one hand through the anterior abdominal wall; knead, compress, and rub it vigorously with the fingers applied to the posterior uterine wall, the palm to the fundus and the thumb in front, until the womb is felt firmly contracting. If external irritation does not effect the desired result,

[1] Müller's "Handbuch," Veit, vol. ii, pp. 121, 130.

insert the free gloved hand into the vagina, pass it into the uterine cavity, feel for retained fragments of the placenta, blood-clots, or other substances that might by their bulk prevent contraction, remove them, and while doing so rotate the hand somewhat roughly, so as to bring it in contact rather forcibly with the uterine wall; at the same time continue the kneading, rubbing, and compression externally. If the combined irritation of the exterior and interior of the womb fails to secure firm contraction, try next the irritating effect of cold. Rub a piece of ice upon the hypogastrium. If the effect of cold is not immediately satisfactory, do not persist in its use, for the ultimate effect is relaxing rather than stimulating. A ready and convenient method of violently chilling the hypogastric region is to pour some ether

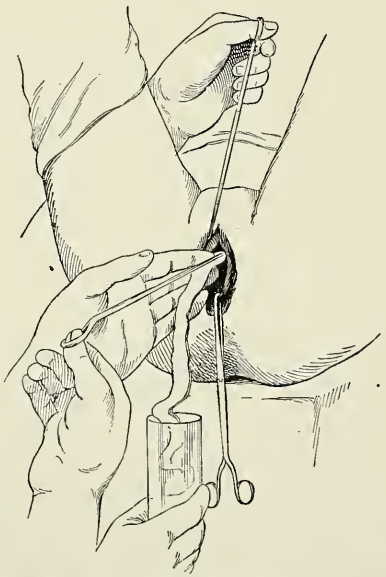


Fig. 465.—Packing the puerperal uterus with gauze to control postpartum hemorrhage (Edgar).

upon it. The irritation of cold externally having proved ineffective, the uterine cavity should be packed with iodoform or sterile gauze. In the intrauterine tampon we possess the surest and most reliable means of controlling postpartum hemorrhage.[1] The technic of inserting the tampon is shown in figure 465. The end of the strip should be inserted as far as the fundus by a long

[1] Dührssen, "Ueber die Behandlung der Blutungen *post partum*," Volkmann'sche Sammlung, 347.

placental forceps, and the *whole* uterine cavity firmly packed with the successive layers.

Other agents of value in promoting uterine contraction are hot water, electricity, and styptic or irritating drugs, such as Monsel's solution, iodin, and turpentine. An intra-uterine injection of very hot water (120° F.) is effective, but it is difficult to regulate the temperature in private practice, and if this means fails, valuable time has been lost. A strong faradic current is extremely efficient, but a battery is scarcely ever at hand when it is needed.

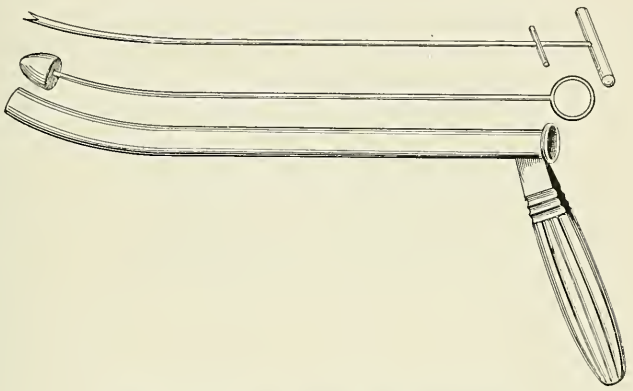


Fig. 466.—Holmes' uterine tube and packer.

Monsel's solution will stop the bleeding, but it leaves such firm and adherent clots in the uterine cavity that septicemia will very likely follow from their decomposition, and there is danger, besides, of an extension of the thrombosis to the uterine and pelvic vessels. Iodin and turpentine have done good service by their irritating qualities, but there is danger of metritis from their use, and they might leak into the abdominal cavity through the tubes. Great virtue has been claimed for special modes of compressing the uterus (Fig. 467) that are supposed to close the mouths of the bleeding vessels. Fritsch advocates pressing the uterus forward and downward over the symphysis pubis, putting a large compress behind and above it, and applying a tight abdominal binder. When these methods are effective it is by irritating the uterine muscle, rather than by the pressure exerted upon the vessels of the placental site. Compression of the abdominal aorta has been proposed as a means of checking postpartum hemorrhage by diminishing the blood supply to the womb. This plan, in my opinion, is absurd. When it has apparently succeeded it was by the irritation of the womb, or of the sympathetic nerves supplying it, on account of the deep abdominal pressure above the fundus.

A plan well worth remembering that has succeeded when others have failed is to seize the lips of the cervix with bullet forceps and to pull the uterus forcibly downward. All operators know that hemorrhage during an operation on the uterus may be controlled in this way.

Finally, the bleeding may cease spontaneously by thrombus

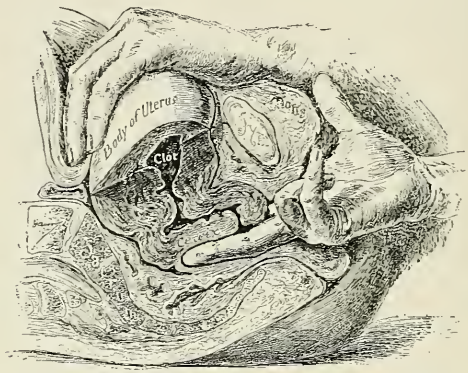


Fig. 467.—Bimanual compression of the uterus.

formation or by syncope, but these agencies are never to be awaited in practice.

The physician's duty is not always done when he has checked the bleeding. An acute anemia must be dealt with that, if disregarded, is as dangerous as a continuance of the hemorrhage. There is a rapid, feeble pulse; or, it may be, an entire absence of radial pulsation. The body-surface, especially of the extremities, is cold, and there is a disposition to syncope on the slightest effort. There is loss of vision, and the acute anemia of the brain may even lead to convulsions. With the dangers of heart-failure and cerebral anemia in mind, the physician, while engaged in stopping the bleeding, directs the nurse to raise the foot of the bed on some books, bricks, or the seats of chairs, and, if there is a tendency to repeated syncope, to give a hypodermic injection of ether; or of nitroglycerin (two drops of one per cent. solution). As soon as the hemorrhage is checked, an enema of a pint of hot water containing about forty grains of common salt should be given. The patient should, in addition, be surrounded by hot bottles, should be well covered with blankets, and should be kept at absolute rest, with the body and head on a straight line and the foot of the bed well elevated to keep as much blood as possible in the brain. Heart-stimulants—digitalis, strychnin, nitroglycerin, and ether—should be given hypodermatically if the

heart-action fails to improve. There is likely to be nausea and vomiting, but, as soon as the stomach will retain what is put in it, the woman should receive very small quantities of hot milk, hot concentrated coffee, hot water and brandy, frequently repeated. When reaction is once established, a hypodermatic injection of morphin hastens the patient's recovery from the effects of the hemorrhage and prevents secondary shock by promoting physical quiet, calming nervous restlessness, and producing some degree of

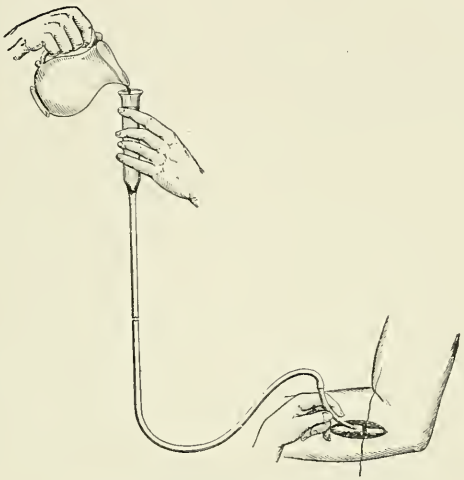


Fig. 468.—Intravenous injection.

cerebral congestion. In desperate cases in which the measures just described are without satisfactory result, a pint to a quart of a sterile normal salt solution (0.6 per cent.), at blood heat, should be injected by gravity into the loose cellular tissue between the shoulder-blades (hypodermoclysis), under the breasts, or directly into an artery or a vein. A convenient apparatus for this purpose is shown in figure 468. A good substitute for the transfusion apparatus is a large aspirating needle and a fountain syringe or funnel. With this appliance, with which every obstetrician should be provided, fluid may be forced into the cellular tissue under the breasts or into a blood-vessel. The funnel and needle should have a place in every well-supplied obstetric-instrument bag.

The extremities should be bandaged toward the trunk (autoinfusion) so as to force as much blood as possible to the heart, the large blood-channels, and the brain. Compression of the

abdominal aorta helps to this end. Actual transfusion of blood from one person to another, or from some animal, is not advisable. It is rarely practicable, and the results are no better than, if as good as, those obtained by the injection of salt solution.

The physician should make it an invariable rule to stay with his patient until her condition is entirely satisfactory. The anemia persisting after the hemorrhage is checked and reaction is established should be treated by a full liquid diet, animal broths, and iron. The intense headaches of cerebral anemia that may persist or recur for some time are best treated with opium.

Actual transfusion by an artificial anastomosis between the radial blood-vessels of a healthy volunteer and the patient is scarcely ever practicable in acute hemorrhage. It may be considered if the patient fails to respond to the treatment just described or if a pernicious degree of anæmia persists. But it is not always successful, and is not free from the risk of embolism.

Lacerations of the Walls of the Birth-canal.—Any portion of the soft structures surrounding the birth-canal, from the fundus uteri to the vulva, is liable to spontaneous rupture, or to traumatic perforation during labor.

Rupture of the Uterus.—The uterus may be ruptured by overdistention of the lower uterine segment. It may burst open from top to bottom in certain diseased conditions of its walls. It may be penetrated by the operator's hands or by instruments. Its wall may be perforated by a localized necrosis and ulceration. If the rupture involves all the coats and opens a way into the peritoneal cavity, it is called complete. If it spares the peritoneal covering of the uterus, it is called incomplete.

Frequency.—The statistics of the frequency of ruptured uterus vary greatly.

Bandl found	1 in	1200	labors.
Jolly found	1 "	3403	"
Lusk found	1 "	6000	"
Collins found	1 "	482	"
McClintock found	1 "	737	"
Ramsbothan found	1 "	4429	"
Garrigues found	1 "	3-5000	"
Winckel found	1 "	666	"
Harris found	1 "	4000	"
Koblanck found	1 "	462	"

Rupture of the uterus is much more common in the poorer than in the richer classes, chiefly because the former have less skilful medical attendants. Multiparæ are more liable to the accident than primiparæ (88 per cent. : 12 per cent., Bandl). Disease of the uterine wall, as fatty degeneration, a myoma, a previous injury to or operation upon the uterus, as a former rupture or Cesarean section, are predisposing causes.

Causes.—The most frequent cause of ruptured uterus in labor is overdistention of the lower uterine segment, due to some obstruction which prevents the descent of the child through the pelvic canal.[1] Bandl first pointed out this fact.[2]

In a normal labor the lower pole of the uterine ovoid is gradually dilated until the fetal body passes through it into the vagina. If there is an insuperable obstacle to the descent of the child, as a contracted pelvis, rigid soft parts, a tumor in the pelvis, overgrowth or enlargement of the child, hydrocephalus, an impossible presentation or position, the contraction of the upper uterine segment continues until the child's body is driven in great part out of it, but, descent of the child being prevented, it is crowded into the enormously distended lower uterine segment and cervical canal, while the firmly contracting upper uterine segment is drawn up under the ribs until it sits upon the child's body like a cap. There is a sharply defined line between the firmly contracted thick wall of the upper uterine segment and the very thin wall of the distended lower uterine segment, a line visible and palpable running across the abdomen between the symphysis and the umbilicus, approaching nearer the latter the greater the distention of the lower uterine segment, the upper boundary of which is normally about the level of the pelvic brim. This line is called the "contraction-ring" or the "ring of Bandl." It ordinarily coincides with the coronary vein of the uterine wall and with the firm attachment of the peritoneum to the uterus. It is not, as it was once supposed to be, the margin of the internal os or the upper limit of the cervical canal; it is the boundary-line between that portion of the uterine muscle which contracts firmly in labor, diminishing the area of intra-uterine space and driving the child out of the uterine cavity, and that portion of the uterine muscle which must be distended in labor to allow the passage of the child through the pointed end of the uterine ovoid. If there is a greater bulk of the fetal body in one side of the lower uterine segment, the contraction-ring is higher upon that side and thus runs an oblique course across the abdomen. There is a limit, of course, to the capacity of the lower uterine segment and to the stretching and tenuity of its walls. That limit being reached, the overstretched wall tears and the fetus may pass from the uterine into the abdominal cavity. In rare cases the uterine wall is weakened by a previous rupture, by a blow or fall during pregnancy, by the scar of a Cesarean section, or by the removal

[1] A contracted pelvis is the most common cause of uterine rupture, and a justo-minor pelvis is the kind of contracted pelvis most often accountable for it. In 1218 ruptures a contracted pelvis was the cause in 570 (Koblanck, "Uterusruptur," Stuttgart, 1895).

[2] "Ueber Ruptur der Gebärmutter," Wien, 1875.

of a portion of the uterine wall in the excision of a myoma; the wall may be weakened by fatty degeneration, associated, perhaps, with excessive general obesity; [1] prolonged pressure upon a small area may destroy its vitality and lessen its resistance. In such cases rupture of the uterus may occur early in labor, or even in pregnancy, without distention of the lower uterine segment. Finally, external violence has ruptured or perforated the womb, instruments inserted in the vagina have pierced its walls, the application of Credé's method to express an adherent placenta [2] and the insertion of the operator's hand in the uterine cavity to perform version have been the immediate cause of rupture.[3]

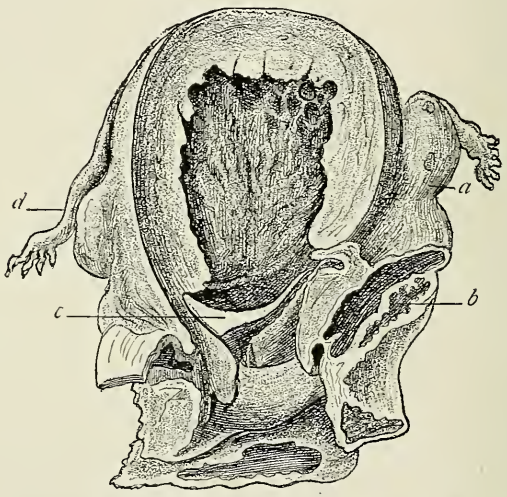


Fig. 469.—Laceration of lower uterine segment: *a*, Right ovary; *b*, rectum; *c*, laceration; *d*, left tube (Winckel).

Morbid Anatomy.—The tear in the uterine wall almost always begins in the lower uterine segment, and usually runs transversely. It may be upon the anterior, lateral, or posterior surface. The edges of the tear are usually ragged, swollen, and infiltrated with blood. The peritoneal covering of the uterus is often stripped off for a considerable distance beyond the tear, and in the sac thus formed between the peritoneum and the body of

[1] In a case of uterine rupture seen with Dr. U. G. Heil, of Philadelphia, the woman had become suddenly and enormously obese before her last pregnancy. She had experienced no special difficulty in the births of her other children, but in the last the uterus ruptured after a few hours of moderate labor-pains.

[2] "Monatschr. f. Geb. u. Gyn.," Sept., 1903.

[3] Koblanck (*loc. cit.*) gives the following causes in 80 cases: Contracted pelvis, 8; transverse position of fetus, 7; other abnormal positions, 4; hydrocephalus, 4; overgrowth of child, 1; misfit of presenting part in pelvis, administration of ergot, 1; violence, 5; version, 29; Hofmeier's grip, 1; forceps, 11; decapitation, 1; myoma, 1.

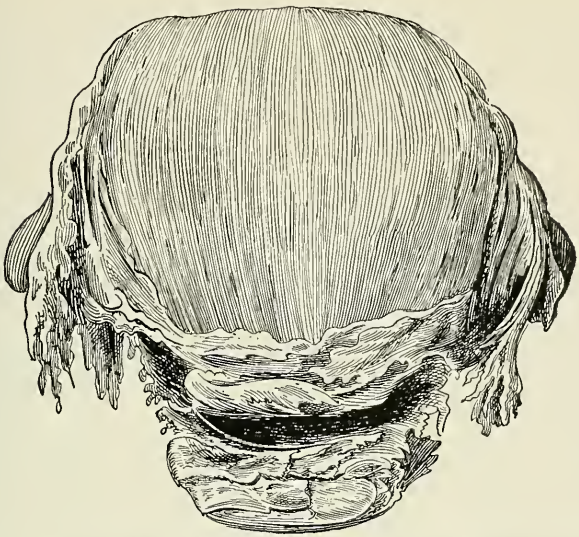


Fig. 470.—Transverse or semicircular tear of the lower uterine segment.

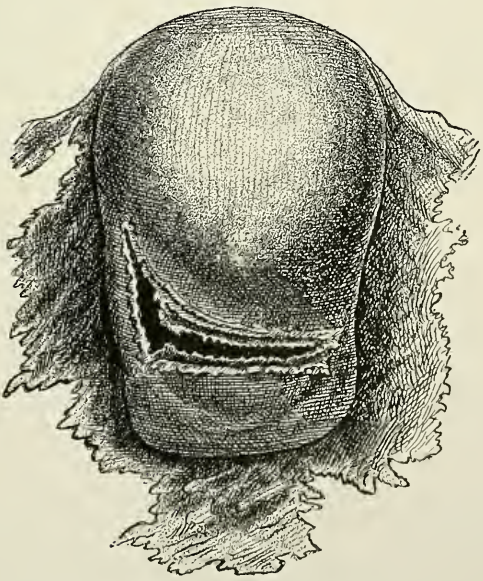


Fig. 471.—Laceration of lower uterine segment.

the uterus the placenta may lie concealed, or even the fetus may be contained. There may be an enormous subperitoneal hematoma or profuse intraperitoneal hemorrhage. The tear may run upward toward the fundus, or may extend so far transversely as almost to sever the upper and lower uterine segments. The rent may extend through the mucous and muscular coats without involving the peritoneum. The latter, in rare cases, may alone be split, and it is recorded in one case that the peritoneal and muscular coats were torn while the mucosa remained intact.[1] If the tear is extensive and complete, the fetal body will probably pass

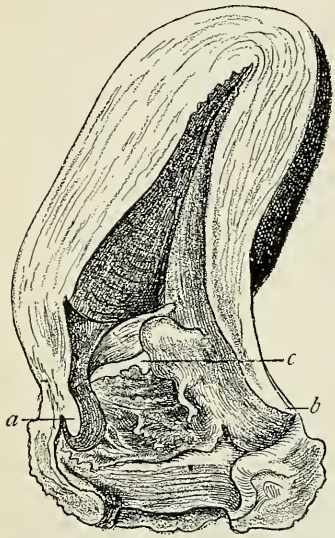


Fig. 472.—Perforating laceration of the cervix: *a*, Posterior lip; *b*, anterior lip; *c*, perforation.

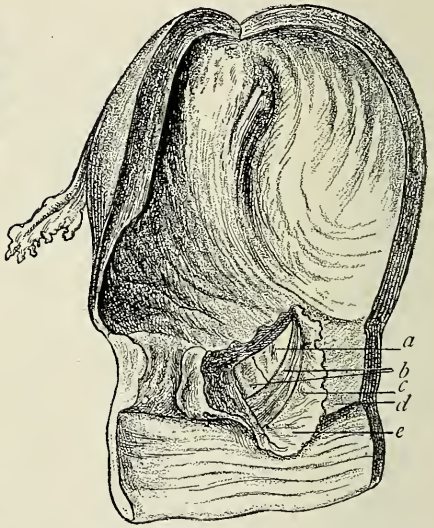


Fig. 473.—Perforating laceration of the cervix: *a*, Perforation; *b*, peritoneum; *c*, muscle; *d*, posterior lip of the cervix; *e*, vaginal laceration (Winckel).

into the abdominal cavity, and intestines may prolapse into the uterus and into the vagina.[2] In one remarkable case[3] there was a tear of the lower uterine segment and of the right lateral fornix of the vagina, through which the fetus entered the vagina, passing to one side of the undilated cervix. Fetal death is usually syn-

[1] J. M. Withrow ("Lancet-Clinic," December, 1891) reports a case of ruptured uterus, the rent beginning in front, midway between the insertion of the tubes, extending up over the fundus and down along the posterior wall to Douglas' pouch, involving the peritoneal coat and the muscular tissue, but not the mucous membrane. The uterus, filled with water after removal from the body, did not leak. A large dose of ergot had been given during labor.

[2] Crossen reports a case in which it was necessary to resect 13 feet of intestine prolapsed through a rent in the anterior wall of the uterus, "Am. Gyn. and Obstet. Jour.," vol. xii, p. 45.

[3] Slajmer, "Centralblatt f. Gyn.," No. 18, 1895.

chronous with the rupture of the womb, and if the child's body passes into the peritoneal cavity it rapidly putrefies, generating gases of decomposition so quickly that its bulk is enough increased to make its extraction difficult. From the decomposition of the fetal body, or perhaps from the entrance of atmospheric air, there may be emphysema of the pelvic connective tissue and of the cellular tissue of the thighs, buttocks, mons Veneris, and abdomen. Septic peritonitis of a virulent kind usually develops with great rapidity. In a minority of cases the site of the rupture is walled off by a rapid outpour of lymph and by agglutination of coils of intestines, leaving a comparatively small cavity to be drained through the tear. This cavity may secrete ascitic fluid in large quantities for a time, and during the woman's convalescence there may be a profuse watery discharge from the womb. I have seen two such cases. Occasionally a large area of intraperitoneal space is drained through the tear. Even the fetal body may be encapsulated, and a lithopedion may be formed. In the uterine ruptures or perforations due to pressure necroses the opening is round in shape, regular in outline, and small in extent. The opening is almost always on the posterior wall over the promontory of the sacrum. In the rare cases of exostoses of the pelvis the bony outgrowth may pinch a hole in the uterine wall. In these cases the opening corresponds to the site of the exostosis.

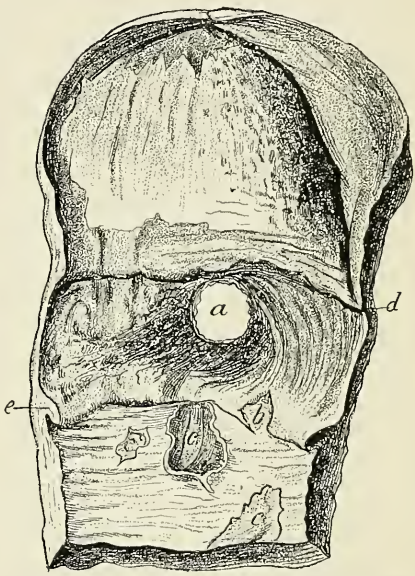


Fig. 474.—Uterus perforated by the pressure of the promontory: *a*, Perforation; *b*, laceration of the cervix; *c*, *c*, *c*, vaginal tears; *d*, contraction ring; *e*, posterior lip of cervix (Winckel).

Clinical History, Symptoms, and Diagnosis.—Rupture of the uterus usually occurs after labor has lasted a long time, after rupture of the membranes, and with a well dilated os. There is usually an obstruction in the labor that should have been recognized, the lower uterine segment is enormously distended, and the contraction-ring is palpable and visible near the umbilicus; the pains have been vigorous and frequent, the woman's suffering has

been extreme, and the abdominal muscles have been employed, perhaps, with each contraction, though the presenting part does not descend the birth-canal. Suddenly there is a sharp, excruciating, lancinating pain; the woman may cry out that something has happened to her; the uterine contractions cease, blood flows from the vagina, perhaps in alarming quantities, and the patient presents every evidence of shock. On making a vaginal examination the physician finds that the presenting part has receded; hitherto easily reached, perhaps at the very outlet of the pelvis, it may be altogether inaccessible, and on passing the hand into the uterine cavity the rent may be felt, or intestines may be found within the uterus and protruding from the os. On abdominal palpation the upper uterine segment may be felt firmly contracted to the size of the uterus after labor, and the child's body may be easily detected in the abdominal cavity alongside of it.

If the rupture of the womb is not complete, or is not large, it may not be discovered until the child is born, and may never be suspected at all unless the woman develops septic peritonitis after labor or discharges ascitic fluid from the uterus. There may be no pain at the time of rupture, no hemorrhage, no abnormality of uterine contractions. Even with a complete tear of large dimensions and escape of the child into the peritoneal cavity there is occasionally an astonishing absence of symptoms. I have seen a case in which the child passed into the abdominal cavity twenty-four hours before I was summoned, and yet there was no alarming symptom of any kind until suddenly, at the end of twenty-four hours, the signs of virulent septic peritonitis appeared. In another case in which I opened the abdomen a month after labor for what was thought to be an intraperitoneal abscess, the fundus uteri was found ruptured from tube to tube, the rent being shut off from the general abdominal cavity by exudate, which was undergoing suppuration. The accident of labor most commonly mistaken for ruptured uterus is premature detachment of a normally situated placenta. The distinction between the two should be made easily by attention to the following differences in symptoms:

Rupture of the Uterus.	Accidental Hemorrhage.
Occurs late in labor.	Occurs before labor or early in the first stage.
Membranes ruptured. Uterus diminished in size by evacuation of some or all of its contents into the abdominal cavity.	Membranes unruptured. Uterus distended, perhaps irregularly in retroplacental effusions.
Recession of presenting part.	Position of presenting part unchanged.
Discharge of blood from vagina.	No external bleeding in the concealed variety.
Exploration of the interior of the womb easy, and rent accessible to touch.	Exploration of the interior of the womb impossible.

As the placenta is often detached when the uterus ruptures, and as it may prolapse in front of the child, a ruptured uterus may be mistaken for placenta prævia.

If the physician should have reason to suspect that the uterus is ruptured during labor, he should extract the child without delay and should then explore the uterine cavity, preferably under anesthesia, from top to bottom. By unvarying adherence to this rule he will not be guilty of the serious fault of overlooking a ruptured womb with few symptoms until septic peritonitis occurs and all treatment is unavailing, or until the bleeding, internal or external, is so profuse that the patient can not be revived.

The symptoms during the puerperium indicative of a ruptured womb in labor are: septic peritonitis, profuse uterine hydrorrhea, secondary hemorrhage (as late possibly as the twelfth day), and prolapse of the intestines. The last is the only positive sign, unless, on the occurrence of the others, a digital or instrumental examination of the uterine cavity reveals the rent.

Prognosis.—The prognosis of ruptured uterus depends upon the site, extent, and degree of the tear, and upon its treatment. In ten cases of rupture of the anterior wall in the Berlin Maternity every one ended fatally, and in three ruptures at the fundus the result was the same.[1] Incomplete ruptures are not so fatal as those in which the peritoneum is also involved, and the result depends somewhat upon the escape of meconium, liquor amnii, blood, placenta, and fetus into the peritoneal cavity. Before the advent of asepsis and the improvement in the technic of abdominal surgery the mortality of ruptured uterus averaged about 90 per cent. Of late years the mortality has been much reduced. In 60 cases of complete rupture without active treatment the mortality was 78.8 per cent., in 70 cases treated by irrigation and drainage the mortality was 64 per cent., and in 193 cases treated by abdominal section the mortality was only 55.3 per cent.[2] In about one-half the fatal cases death occurs within the first twenty-four hours. The great majority of the remainder die within three days. In some fatal cases, however, death occurs as late as the tenth or fourteenth day. The causes of death, in the order of their frequency, are sepsis, hemorrhage, and shock. The mortality of the infants is usually over 90 per cent. In the 80 cases from the Berlin Maternity 10 children were saved, but this is an unusually large proportion. If the woman recovers from the rupture, she runs a great risk of a repeated rupture in a subsequent pregnancy

[1] I have performed hysterectomy for a complete rupture of the uterus across the fundus, with success, in one case.

[2] Schultz, "Internat. med. Rundsch.," Jan. 10, 1892.

and labor. There are cases on record, however, of women safely delivered in a subsequent labor. Couvelaire,[1] in 17 women who had had a ruptured uterus and again become pregnant, reports 9 cases of repeated rupture, with 6 deaths.

Treatment.—The preventive treatment of uterine rupture consists in obviating, in time, the obstructions in labor that predispose to the accident.

If a woman has had a ruptured uterus and becomes pregnant again, she should be delivered by Cesarean section before she falls in labor.

The treatment of the rupture itself differs as the rent is complete or incomplete, as its situation admits of good drainage or otherwise, and it depends greatly upon the escape of foreign matter into the peritoneal cavity. The first care of the physician must be to extract the child and to control the hemorrhage. If the child has escaped into the abdominal cavity, no effort should be made to extract it by the natural passages, but it should be removed through an abdominal incision. If the rent is small, and the child has only in part passed from the uterine cavity, it should be delivered rapidly by version, the application of forceps, or by craniotomy. The last is to be preferred. The placenta may be removed by the vagina, even though it has passed into the abdominal cavity; but if difficulty is experienced in finding it, if the cord should break off by the efforts to pull the placenta through the rent, or if the placenta lies hidden under the peritoneum stripped off the womb, its extraction should be postponed until the abdomen is opened. In an incomplete tear it is sufficient to pack the rent with iodoform gauze, in order to control hemorrhage and to secure good drainage. This may be preceded by irrigation, which may be repeated with advantage when it becomes necessary to renew the gauze packing. If the rent is complete, but small, and situated low down upon the posterior wall; if there has been little, if any, foreign matter injected into the peritoneal cavity, the same treatment will suffice; but if the tear is extensive, if considerable blood has passed into the peritoneal cavity, and, all the more, if the peritoneum has become contaminated by the entrance of liquor amnii, of the placenta, or of the child itself, an abdominal section will be necessary. With the abdomen open a decision must be made between several plans of procedure. Usually, it is best to amputate the womb, if possible, below the site of the tear. Occasionally, if the wound is not too ragged and can be thoroughly approximated, it will be sufficient to unite it with deep and superficial sutures, care being taken to cover over the line of rupture with inverted peritoneum. In case the peritoneum is stripped off the womb for a considerable distance,

[1] "Rev. prat. d'Obstet. et de paed.," Oct.–Dec., 1903.

and it is impossible to secure a good stump, a flap of peritoneum may be dissected off the uninjured side of the womb and used to cover over the upper portion of the stump and its denuded surface; or it may be preferable to do a panhysterectomy, sewing up the opening left in the vagina in such a manner as to cover any denuded surfaces. If the tear is on the anterior wall, or at the fundus, an abdominal section is necessary. On opening the abdomen one of the procedures detailed above may be adopted, or it may be possible, as it was in one of Leopold's cases, to splint the womb by gauze packing in the pelvis and abdomen, so as to bring the torn surfaces firmly together.

In an abdominal section for ruptured uterus the toilet of the peritoneal cavity must be made, of course, with the greatest care. It is better, if possible, to cleanse the abdominal cavity with pads of gauze, rather than to flush it with water; but the latter plan is sometimes necessary to remove small clots of blood scattered throughout coils of intestines or hidden in the depths of the pelvis. Resection of the intestines and intestinal anastomosis is occasionally required. In one of my cases the medical attendants had pulled off both arms of the child in attempts to extract it, and then through a rupture of the lower uterine segment had pulled two feet of ileum loose from its attachment to the mesentery.

Injuries to the Cervix.—The cervix is injured to some extent in every labor, but serious tears, that cause at the time profuse hemorrhage and give rise to symptoms subsequently, are comparatively rare. The causes of serious injuries to the cervix are: precipitate delivery, premature rupture of the membranes, forcible extraction of the child by the forceps or after version before the os is thoroughly dilated, incarceration of the anterior lip of the cervix between the child's head and the pelvis, and abnormal rigidity of the cervix. The tear is usually bilateral, occasionally unilateral, in rare cases multiple, and in one instance under the writer's observation directly in the anterior median line. In rare instances the tear, instead of being longitudinal, may be circular, and in consequence the vaginal portion of the cervix may be completely torn off from the womb.

The cervical tear manifests itself immediately after delivery of the child, usually by some hemorrhage, occasionally by profuse and dangerous bleeding. A digital examination of the vagina directly after the extraction or expression of the placenta informs the physician of the condition of the cervix, and, if the cervix is inspected through a speculum during the puerperium, a torn cervix that needs attention should never be overlooked.

The hemorrhage from a torn cervix directly after labor may be controlled in two ways. First, by ligatures, which are perfectly certain to effect the desired result, but which are not always

easy to insert, and which increase the danger of septic infection, unless the attendant possesses gynecological skill and has the necessary equipment for operating in a perfectly aseptic manner.

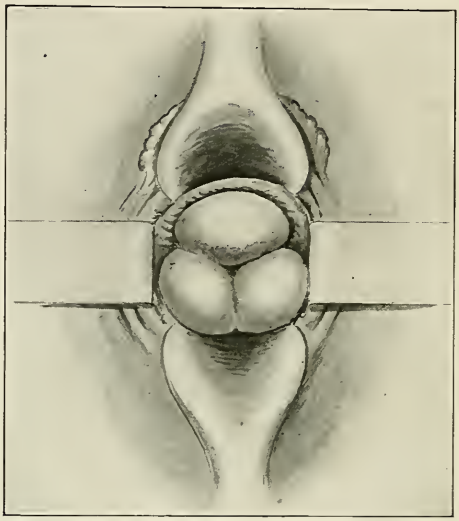
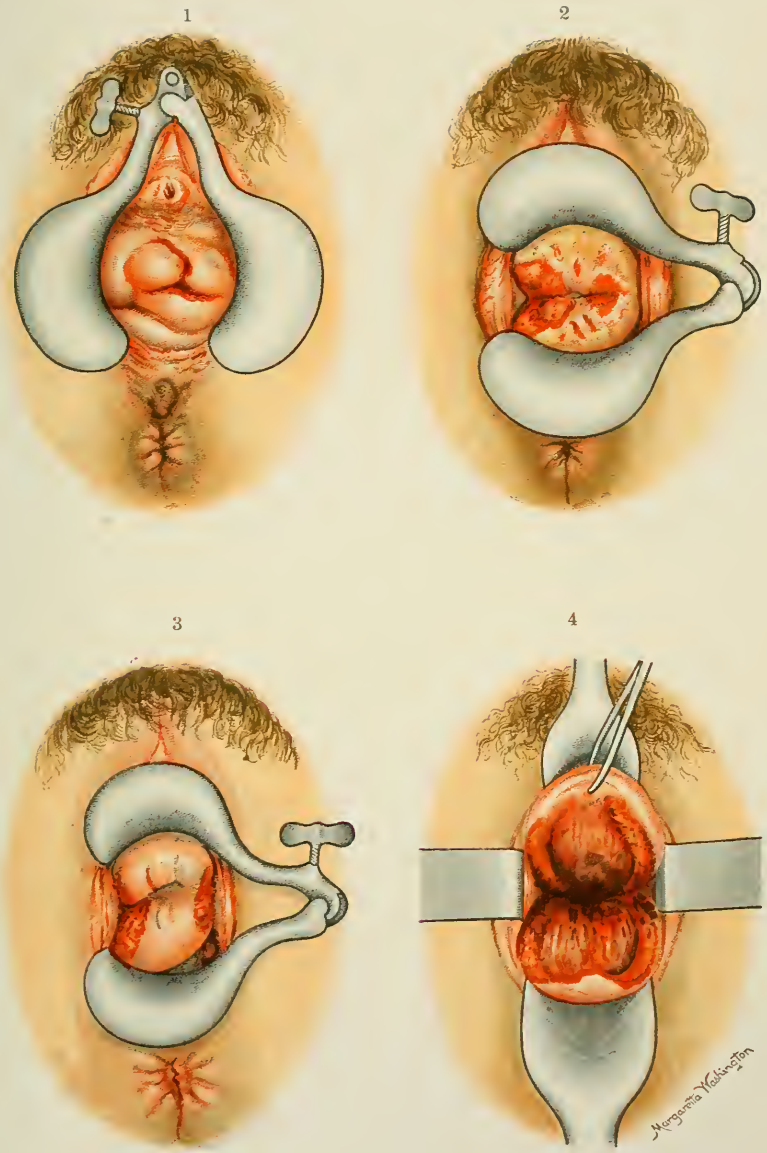


Fig. 475.—Spontaneous repair of a stellate laceration of the cervix. Drawn from life, three months after labor.

The easiest, and on the whole safest, plan for checking the hemorrhage from a torn cervix in general practice is to insert a tampon in the form of a half ring in the lateral vault of the vagina. The best tampon material is iodoform or sterile gauze. I have never known this device to fail in checking hemorrhage from a torn cervix.

It is a moot question whether a torn cervix should always be repaired in the early puerperium. In general practice, the following arguments are usually advanced against the primary repair of the cervix: Stitches placed in a relaxed cervix directly after labor will probably not be tight enough at the end of twenty-four hours to close the wound. To place them properly requires considerable skill, and necessitates dragging the cervix into view by bullet forceps. The necessary instruments are rarely to be found in the general practitioner's armamentarium, and many lacerated cervices heal spontaneously, if the woman is kept quiet on her back in bed for a sufficient length of time, without vaginal douching or other interference that could disturb the approximation of the edges of the tear. In a well-equipped clinic or in the private practice of a specialist, on the contrary, the repair of lacerated cervices during the puerperium is recommended. It is the author's

PLATE 12.



Lacerations of the cervix: 1, Two weeks after labor; 2, one week after labor; 3, four days after labor; 4, immediately after labor. The degree of involution shown in No. 1 should be awaited before repairing the cervix.

practice. It is better to wait five to seven days after labor. Clinical experience has shown that there is less danger of infection in the intermediate than in the primary operation.

Circular Detachment of the Vaginal Portion of the Cervix During Labor.—Rarely the whole vaginal portion of the cervix is torn off from the womb and emerges from the vulva in front of the child's head. This accident may be the result of extreme rigidity of the cervix, or of the cervix being caught between

Figs. 476 and 477.—Author's cases of annular detachment of the cervix.

the walls of the pelvis and the child's head, if the former is contracted or the latter is very large. I have seen three cases, all due to extreme rigidity of the cervix (Figs. 476, 477). In each case the woman was an elderly primipara, and was quite obese. One of them was delivered a year later under my charge without

difficulty. In one case (Fig. 476) there was a narrow tab of cervical tissue left in the median line posteriorly. Although the injury at first sight appears serious, there is no hemorrhage, nor is the puerperal convalescence disturbed. This accident could almost always be averted by multiple incisions in the cervix.

Lacerations of the Vagina.—The vagina may be torn by the insertion of the hand, by the rapid extraction of the child, by the extension of tears from the cervix, by the propulsion of the child's body against the posterior wall without sufficient deflection forward to facilitate its escape from the vulvar orifice, and, most frequently of all, by the blade of a forceps which does not fit the child's head properly, or which is not used with sufficient care as to the direction of the force that is applied in the extraction of the head.

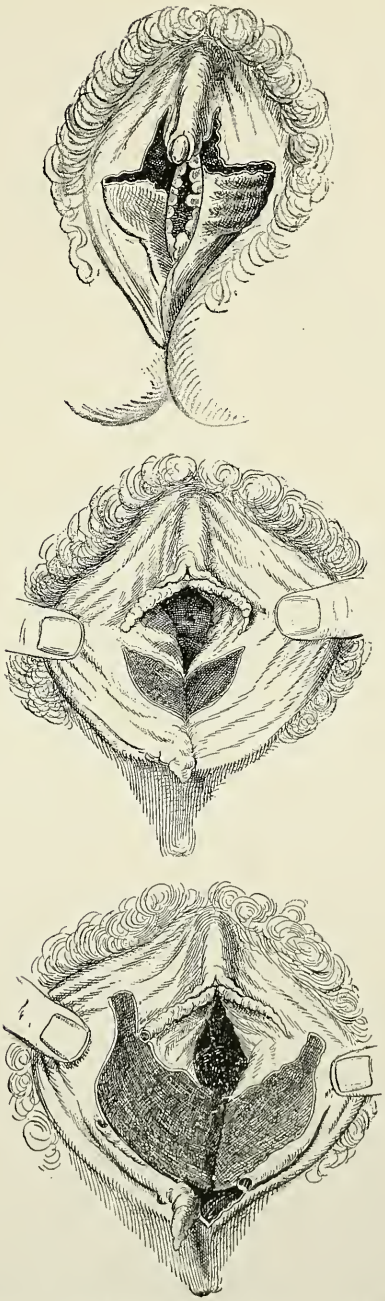
The tears of the vagina accompanying a lacerated perineum or injured pelvic floor are described under the latter heading.

Tears of the vagina extending from the cervix involve usually the lateral vaginal vaults, occasionally opening deep rents into the base of the broad ligaments, and involving possibly the uterine arteries or even the ureters. The hemorrhage from these tears is best controlled by ligating the bleeding vessels if they can be found, or by firmly tamponing the rent if it is impossible to locate the bleeding points. Drainage must be secured by gauze packing, and, when the wound begins to granulate, daily washing with sterile water should be employed. The tears of the posterior vaginal wall sometimes result in perforations of the rectum, and in consequence a portion of the child, as an extremity, may emerge from the anus.[1] These perforations should be repaired immediately after labor by buried running sutures of catgut and interrupted stitches of silkworm gut.

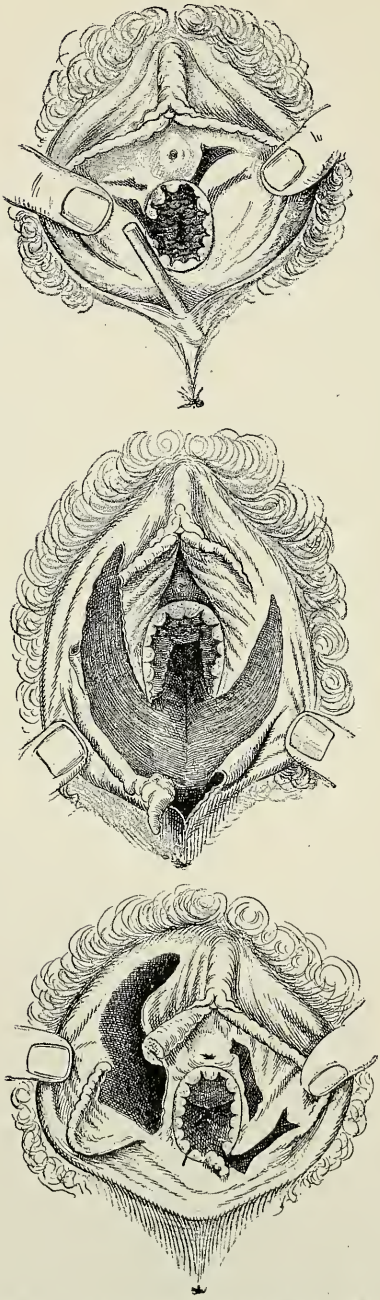
The tears of the anterior vaginal wall made by a forceps-blade are almost always clean-cut, and are apt to bleed profusely. They should be closed by a running catgut suture. In one case under my care the hemorrhage was so profuse that it was impossible to see the wound at all, and there was danger of the woman bleeding to death while I attempted to sew it up. After several abortive attempts the wound was successfully repaired without further bleeding by pushing a tampon into the vagina and following the tampon as it was pushed up along the course of the wound with a needle and thread, until the upper end of the tear was reached.

Lacerations of the anterior and posterior vaginal vaults penetrating to the peritoneal cavity are usually associated with rupture of the uterus. They are to be treated by gauze packing and drainage.

[1] Piering, "Centralblatt f. Gyn.," No. 48, 1891. See also Engelmann, *ibid.*, No. 46, 1900.

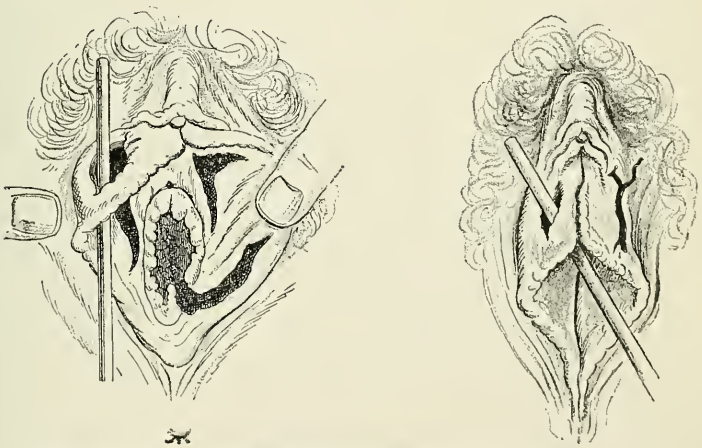


Figs. 478, 479, and 480.—Lacerations and abrasions of the vestibule and vaginal entrance (Bar).



Figs. 481, 482, 483.—Lacerations and abrasions of the vestibule and vaginal entrance (Bar).

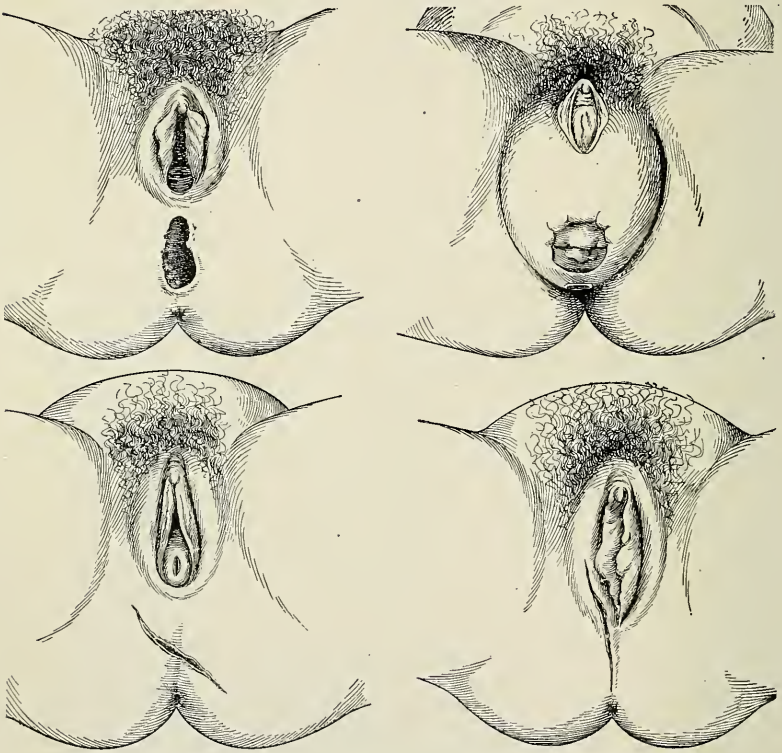
Lacerations and Abrasions of the Vulva, of the Vestibule, and of the Vaginal Entrance.—The most frequent site for injuries in this region is the upper portion of the vestibule and the tissues on one side of the clitoris or of the urethra. Tears in this situation bleed profusely, and they are so common that it is a valuable rule of practice always to look in this region for injury when there is a hemorrhage from the vagina after labor with a well-contracted womb. The bleeding points are in plain sight, and the hemorrhage is easily controlled by a stitch or two, deep enough to undersew the whole depth of the tear. A catheter should be placed in the urethra to guard against occluding it. In abrasions of the labia and of the vestibule, care must be taken that the raw surfaces shall not unite, causing atresia of the vagina. This can easily be prevented by laying oiled lint over the raw surfaces, and by the use of douches.



Figs. 484 and 485.—Perforations and lacerations of the nymphæ (Bar).

Lacerations of the Perineum.—The causes and preventive treatment of lacerations of the perineum are considered elsewhere. The extent, situation, and recognition of the injury are dealt with in this section. The commonest form of torn perineum is shown in Plate 2 and in Figs. 492 and 493. It may be seen that the tear rarely involves the perineum alone, but usually extends up the posterior wall of the vagina, on one or both sides of the posterior column. Experience teaches, moreover, that lacerations of the perineum alone, when they do occur, have very little effect upon the patient's after-condition, even though they reach to the anus and sever the transverse perineal muscle (see Figs. 496, 497). The

greatest care should be exercised, therefore, to ascertain the extent of the injury to the vagina which is associated with the tear of the perineum. This is best done by placing the woman in the dorsal position across the bed or on a table, with her thighs well flexed upon the abdomen and widely separated, and with the buttocks projecting beyond the edge of the bed or table. A nurse or other assistant, whose hands are protected by sterile gloves, holds the labia apart, and the physician cleanses the torn surface of the poste-



Figs. 486, 487, 488, 489.—Varieties of central tear of the perineum ("Précis d'Obstétrique").

rior wall of the vagina with pledgets of sterile cotton. In this way the exact nature and the extent of the injury may be seen. If the tear is complete,—that is, through the sphincter,—the fact should be evident on inspection. If there is any doubt about it, the forefinger of the left hand is inserted in the anus, the thumb in the vagina, and the thickness of tissues between, or their absence, can thus be appreciated. It is a serious error to overlook a complete tear. Many suits for damages have been based on this

PLATE 13.

Lacerations of the perineum (painted from life a few hours after their occurrence).

ground. A central tear or perforation of the puerperium presents the appearance represented in Figs. 486–489. A probe passed into the vagina through the perineal wound shows the nature of the injury. The laceration may be immediately repaired; but the author prefers repairing all the injuries of childbirth at the end of five to seven days after delivery, making a formal plastic operation. After trying the different periods for repair work, from a few minutes after labor to the end of the puerperium, in series of many hundreds of cases, the end of the first week has been found the best time. Immediately after labor the tissues are bruised and edematous; the bloody discharge is profuse and embarrassing; it

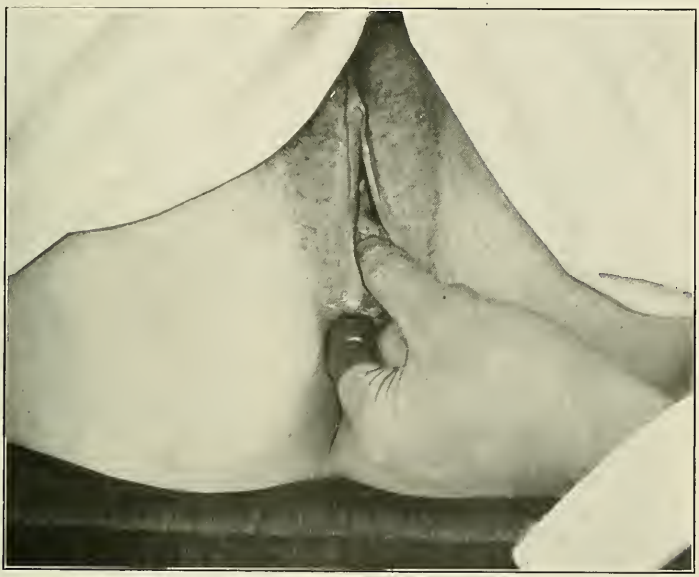


Fig. 490.—Testing the thickness of tissues between the rectum and the vagina.

is impossible to make an accurate diagnosis of the extent of the injury and it is unwise to repair the cervix. Repairs of the perineum and pelvic floor at this time are often failures and must be done again. By waiting a week the tissues are in more favorable condition for good union, and it is possible to make a careful examination of the whole genital canal and to repair every one of the injuries of childbirth. If the woman is infected, has kidney disease, or has had a serious hemorrhage, it is desirable to wait several weeks. The operation should be performed on a suitable table, with sufficient assistants and implements, and under anesthesia.

Injuries of the Anterior Vaginal Wall.—There is quite frequently a submucous laceration of the muscle and fascia of the urogenital trigonum (Waldeyer) in the anterior sulci, usually most marked in the left. This muscle is the main support of the lower

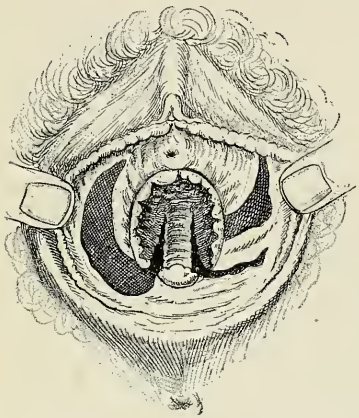


Fig. 491.—Abrasions of the vulva and lacerations of the vaginal sulci (Bar).

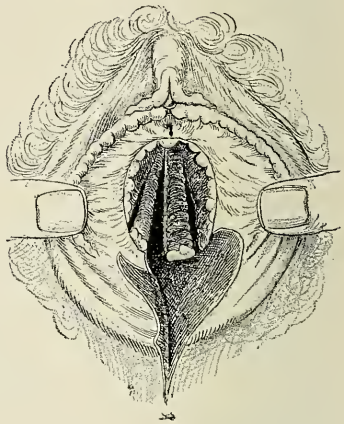


Fig. 492.—Deep laceration of the perineum and of one sulcus; splits in the vaginal mucous membrane (Bar).

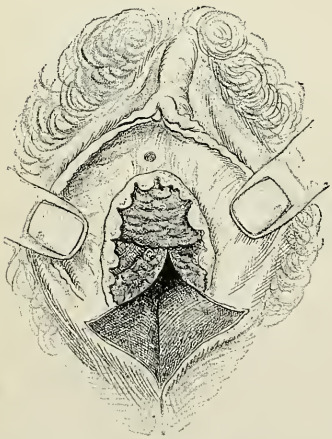


Fig. 493.—Laceration of the perineum and of one sulcus (Bar).

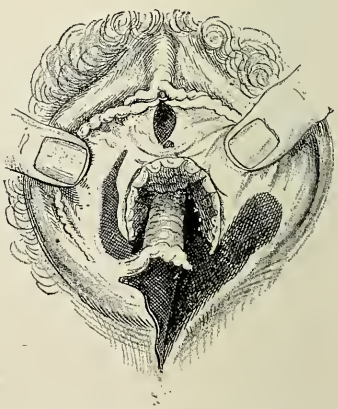
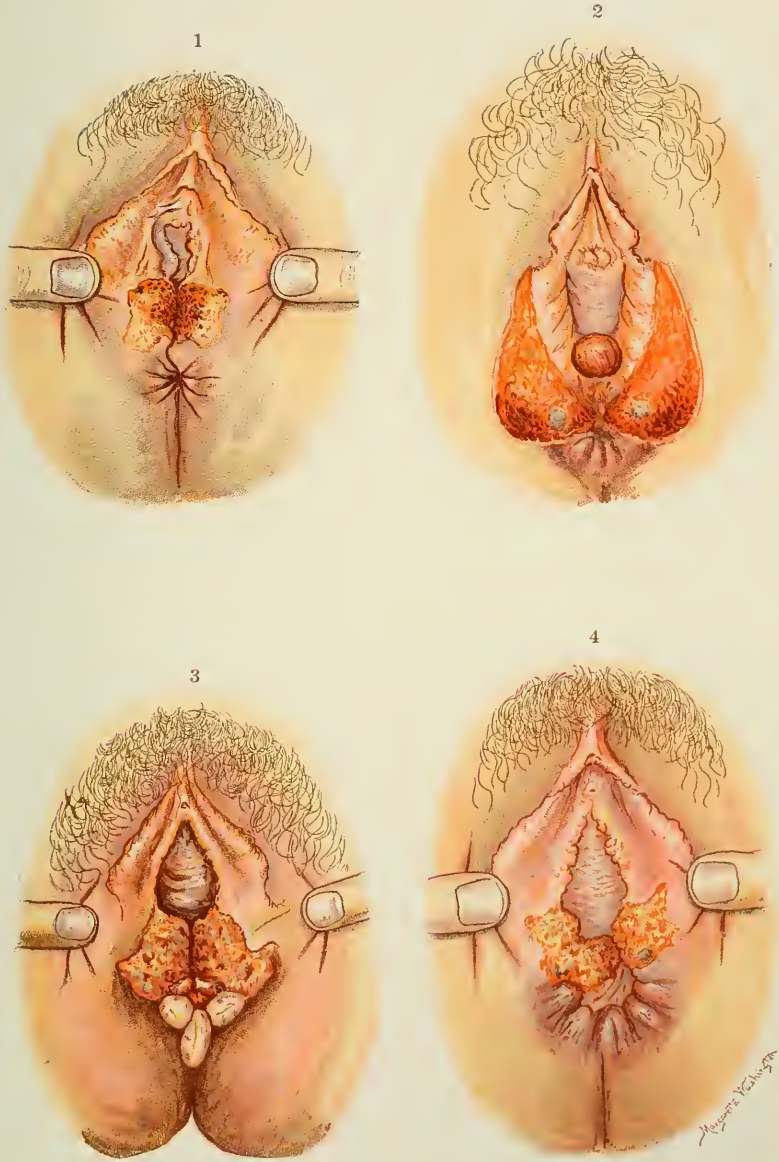


Fig. 494.—Laceration of the perineum and of the sulci; abrasions of the vulva (Bar).

anterior vaginal wall. Its laceration allows the anterior wall to drop backward and outward. The constant drag of this prolapsed portion of the wall upon the structures above is one of the factors that causes a cystocele in the course of time. The injury can be

PLATE 14.



Complete tears of the perineum (painted from life a few hours after the injury): 1, Tear involving some of the fibers of the sphincter, but not all; 2, median complete tear, with abrasion of the vulva, and two large hemorrhoidal veins exposed, one on either side; 3, complete median tear, with sphincter muscle hidden by three large hemorrhoids; 4, lateral complete tear, involving left vaginal sulcus.

recognized by pressing a finger upward against the pubic bone. The presence or absence of the muscle is easily determined.

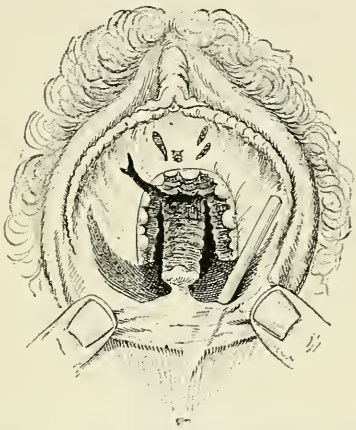
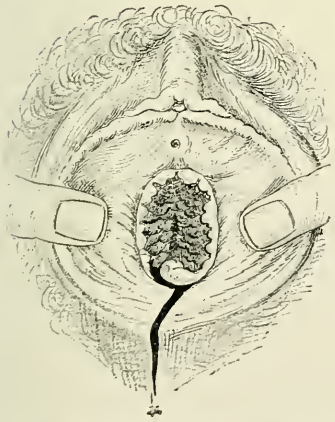
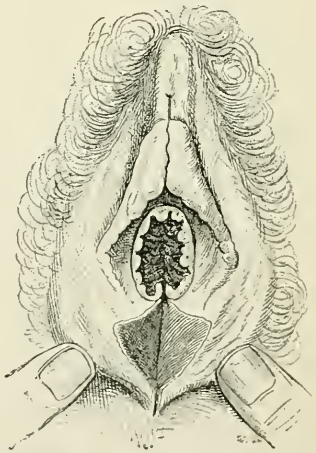


Fig. 495.—Laceration of the vaginal sulci without a tear of the perineum proper (Bar).





Figs. 496 and 497.—Lacerations of the perineum without involvement of the pelvic floor. Such tears would not affect the woman's health or comfort subsequently (Bar).

Inversion of the uterus is the rarest of all the accidents to a parturient woman. In the Vienna Maternity, from 1849 to 1878, in more than 250,000 labors, there was not a case. In the Rotunda Hospital, in Dublin, there were 190,000 labors, with only one inversion of the womb. Winckel did not see a case in 20,000 labors. My own experience amounts to six cases—five complete

and one partial.[1] In general practice, especially among the poorer classes, inversion of the womb is not so rare. The accident happens with equal frequency before and after the delivery of the placenta. It is commoner in young primiparæ than in multiparæ. It is reported to have occurred on the third, fifth, sixth, and fifteenth day of the puerperium,[2] and has recurred on the fourth day.[3] The inversion may be partial or complete, the former when the fundus simply protrudes into the uterine cavity, the latter when the womb is turned completely inside out. In a complete inversion the fundus is just within the vulva; the cavity of the womb is formed by the peritoneal surface, the orifice looking upward into the peritoneal cavity. From this cavity the tubes and the ovarian and round ligaments run upward; the ovaries are usually above and to either side of the orifice. Inversion of the womb may be associated with inversion of the vagina. In such a case the inverted womb is also prolapsed.

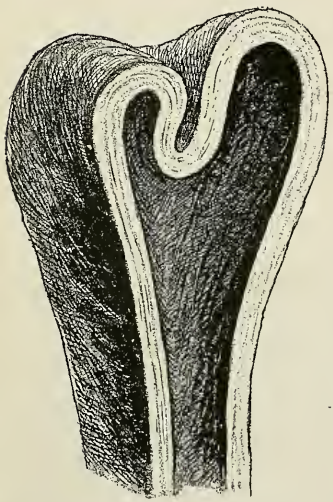


Fig. 498.—Partial inversion of the uterus.

Causes.—Inversion of the uterus may occur spontaneously. In the so-called paralysis of the placental site,—a condition in which this portion of the uterine wall becomes so relaxed and flabby that it sags down into the uterine cavity,—the projecting portion of the wall, it is said, is seized upon by the remainder of the uterine muscle as a foreign body, and depressed further and further toward the cervical canal, as a polypoid tumor might be expelled. The explanation, however, is strained. A contraction of the uterine muscle under these circumstances would reinvert the womb. A much more plausible explanation for spontaneous inversion is found in an adherent placenta and entire relaxation of the uterine walls. In this condition of affairs the mere weight of the placenta is

[1] Three cases were seen directly after labor; two were reduced by taxis; the other spontaneously. One case of complete inversion was reduced five days after labor by taxis; another three months after labor by the author's operation. The sixth case of inversion was due to a myomatous polyp at the fundus. It was complete, but was easily reduced by taxis after the removal of the polyp.

[2] Lepage, "Comp. rend. Soc. d'Obstet. de Gyn. et de Pædiatr.," 1905, p. 213.

[3] Fisher, "Br. Med. Jour.," 1896, vol. ii, p. 1178; and Burton, "Am. Jour. of Obstet.," vol. xxxvi, p. 548; "v. Winckel's Handbuch der Geburtshülfe," III. Band, II. Theil, 1906, p. 162.

enough to drag the fundus down into the uterine cavity. A most favorable predisposing cause is furnished by a complete inertia uteri at the close of the second stage of labor. The expressive force of the abdominal muscles not only expels the child's body, but drives down the uterus after it. Inversion of the uterus may be most frequently explained by traction on the cord in the third stage of labor, when the placenta is adherent. It may occur in consequence of a short cord pulling upon the placenta

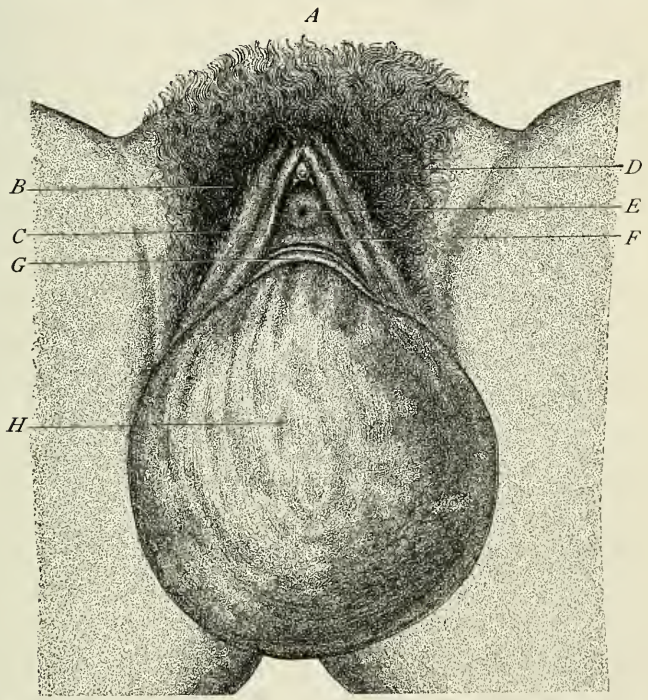


Fig. 499.—Complete inversion with prolapse: *A*, Mons veneris; *B*, labia majora; *C*, labia minora; *D*, clitoris; *E*, urinary meatus; *F*, external anterior border of the vagina; *G*, external border of the os uteri; *H*, the internal surface of the uterus, now external (Boivin and Dugés).

during labor. It has followed precipitate birth in the erect posture, straining the abdominal muscles to pass urine or to expel the placenta, the woman sitting erect, violent coughing or vomiting, and carrying a weight up stairs directly after delivery. In a case under my observation the cord was wound three times around the child's neck. It is sometimes due to too vigorous compression of the fundus in efforts to express the placenta, and I have seen it occur on one occasion in an effort to extract an adherent placenta, in which the hand and the placenta grasped within it acted like the piston of a syringe and drew the fundus down into the uterine cavity.

Another case under my observation appeared to be due to the universal adherence of the membranes after the detachment of the placenta. The weight of the latter, dragging on the uterus by the membranes, turned it inside out. A necessary predisposition to inversion of the womb is relaxation of its walls. If the uterus is firmly contracted, the accident cannot occur.

Symptoms.—Inversion occurs suddenly, and is usually associated with profound shock, and often with some hemorrhage. The patient at once passes into a most alarming condition, that can scarcely fail to attract any one's attention. The only causes for her condition would be hemorrhage, rupture of the uterus,

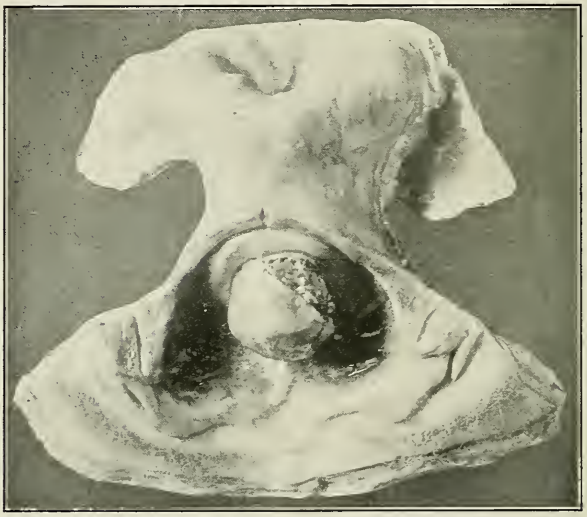


Fig. 500.—Partial inversion of the uterus.

syncope, or inversion. An immediate vaginal examination should always be made, whereupon the nature of the trouble should manifest itself at once. The inverted uterus is found filling up the vagina, and almost projecting from the vulva. By abdominal palpation one notes the absence of uterine tumor in the hypogastrium, and can detect, moreover, a groove or slit running across what remains of the cervix. If necessary, a rectal examination would reveal the absence of the womb and the depression in the cervix where it is inverted even more plainly than these signs could be detected by abdominal palpation ; but a rectal examination should scarcely ever be necessary. The cervix itself remains uninverted as a collar about the lower uterine segment. Between the cervix and the uterine wall a sound or the finger may be inserted a little way, but it is impossible to find a uterine cavity. This fact should always make the distinction between an

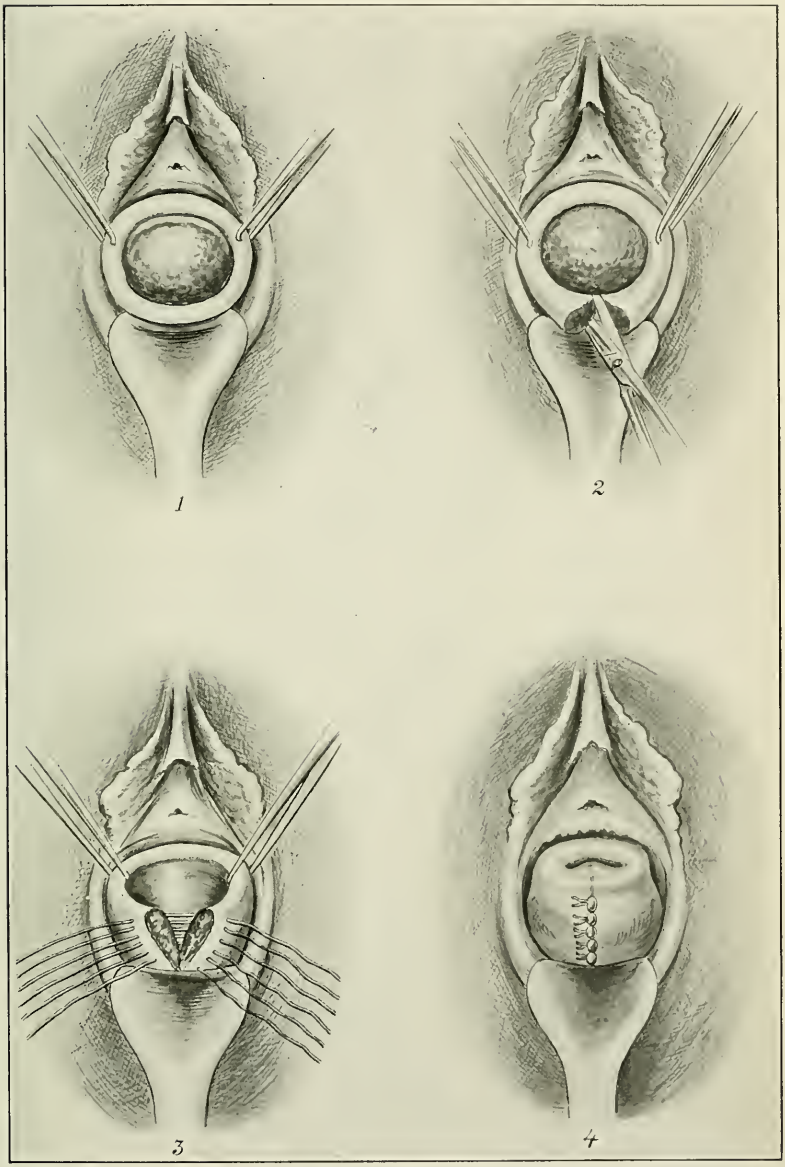


Fig. 501.—Inversion of the uterus and the author's operation for its correction: 1, Complete inversion, 3 months after labor; 2, discission of the cervix through its entire length, supravaginal as well as infravaginal portion; 3, inversion corrected and sutures introduced; 4, sutures fastened.

inverted womb and a fibroid polypus or other tumor projecting from the uterine cavity. Mistakes, however, of the most serious character have been made in this connection. In one case the inverted womb was torn away in the belief that it was a fibroid tumor, and in another the wire of an écraseur was adjusted about an inverted womb, and was about to be screwed tight, when the true character of the mass in the vagina was detected.

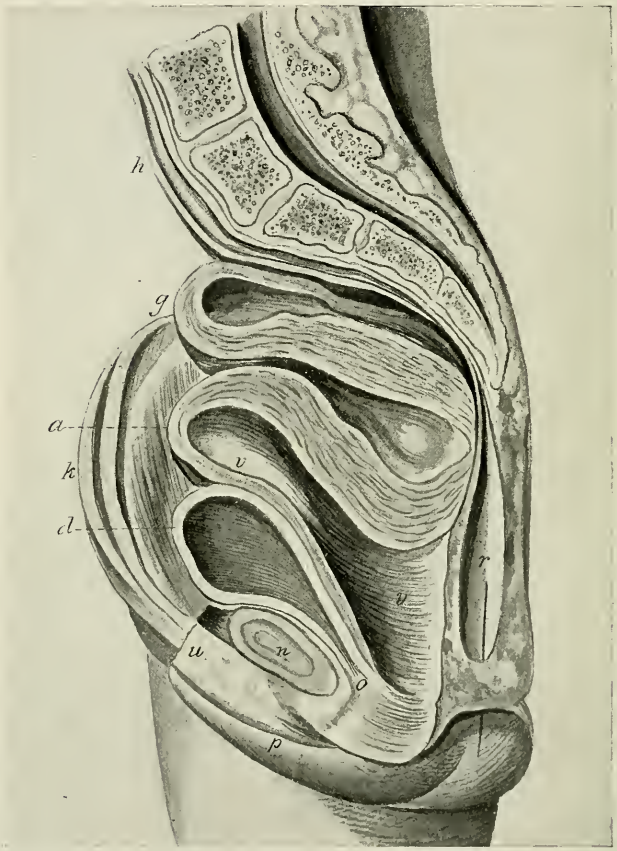


Fig. 502.—Inversion of uterus showing necessity of pressure forward in taxis for its reduction.

Treatment.—Occasionally, a spontaneous reduction of the inversion occurs, especially when inversion is partial. This occurred in one of the six cases under my observation. If the inversion is complete, spontaneous reduction cannot be expected. If the placenta is still attached to the uterus, it should be first removed, and then pressure exerted with the fingers upon the lower

uterine segment in a direction forward and slightly upward. To do this, the hand must be inserted well into the vagina and back toward the sacrum, and the fingers must then be directed well forward toward the anterior abdominal wall, in the direction of the axis of the superior strait. The mistake is almost always made of pressing upward against the sacrum, so that the efforts to reduce the womb may fail altogether, and a chronic or permanent inversion may be left for the surgeon to deal with after the puerperium is completed. With the proper direction of force in one's effort to reduce

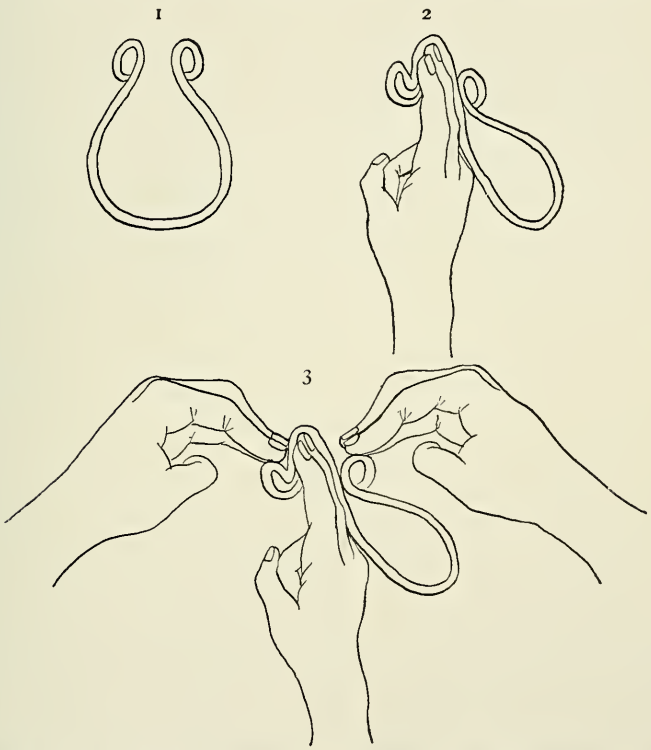


Fig. 503.—1, Complete inversion of the uterus; 2, first manœuver to reinvert the lower uterine segment; 3, second manœuver to widen cervical ring and afford counterpressure by an assistant.

an inverted uterus, failure ought to be almost unknown, if the reposition of the womb is undertaken at once, as it always should be. If there has been a deep tear of the cervix, the best place to begin the reinversion is just below the upper margin of the tear. I succeeded by this plan in one case after two other physicians had failed and after my own attempts at reduction by pressure on the lower uterine segment posteriorly had been futile.

Strange as it may seem, the inversion has been overlooked for some days or altogether in quite a large proportion of the cases. If the cervix is allowed to contract firmly, as it will in a few hours, the reposition of the womb becomes extremely difficult. In one of my cases, seen in consultation, five days had elapsed since the woman's delivery. She had suffered great pain, had considerable fever, with a foul discharge, and had a very rapid pulse, yet no vaginal examination had been made, although the patient was in charge of a professed expert in gynecology! The uterus was completely inverted. Reposition was finally accomplished by the following plan: One hand, made into a cone shape, was inserted in the vagina and the finger-tips were pressed steadily against one side of the lower uterine segment, forcing it into the cervical ring. After steady pressure for almost an hour, the cervix yielded considerably. Then an assistant helped in the dilatation of the cervical ring, in the manner shown in figure 503, and at the same time made counterpressure downward upon the cervix. The womb was returned to its natural position shortly after this manœuver was tried. The woman recovered. If taxis fails, the cervix may be cut in two in the median line posteriorly from the external os to the lower uterine segment. As soon as the obstruction of the contracted cervical muscle is removed the uterus may be reinverted without difficulty. The wounds in the cervix and vaginal vault are closed with interrupted sutures. Some of those in the supravaginal portion of the former may have to be buried, and should be of catgut. This operation has distinct advantages over those of Barnes, Gaillard Thomas, Browne, and Küstner.[1] The separation of the anterior cervical wall from the bladder and its complete discission may be more effectual than posterior discission.[2] If it should be impossible to reinvert the uterus after complete discission of the cervix, Spinelli's operation—dividing the posterior or anterior uterine wall as well as the cervix—may be tried.

Prognosis.—The mortality of inversion of the womb has been extremely high. In one series of 109 cases there were 80 deaths, and 72 of these within a few hours after labor. In another series of 54 cases there were 12 deaths (Winckel). The six cases under my care recovered. The causes of death are: shock, hemorrhage, sepsis, peritonitis, and exhaustion from long-continued loss of blood.

[1] Bernard Browne, "Tr. Am. Gyn. Soc.," 1899.

[2] Oui, "Ann. de Gyn. et d'Obstet.," Oct., 1901. Good bibliography. Also Reuben Peterson, "The Conservative Operative Treatment of Chronic Inversion of the Uterus," "Am. Gyn.," June, 1903.

Injuries of the Urinary Tract; Genito-urinary Fistulæ.— The commonest fistula is vesico-vaginal, due to pressure necrosis of the vesico-vaginal septum in a prolonged labor. The bladder wall has been punctured or ruptured by the blunt hook; by forcible delivery with forceps, in cases of cystocele distended with urine; by craniotomy instruments; by spicules of fetal bone; by unskilful extraction of the head after version; by a vesical calculus caught between the fetal head and the maternal symphysis and by rough intravaginal manipulations. The first symptom to attract attention is incontinence of urine. A visual examination, the use of a sound in the bladder, injections of colored fluid into the bladder, indagation, and, if necessary, cystoscopy, make the diagnosis certain. If there is no loss of substance, the injury may be primarily repaired. Sometimes the opening, if small, is closed spontaneously by granulation tissue. Usually a secondary operation is required, which should be performed, if possible, four to six weeks after labor.

Rupture of the symphysis occurs not infrequently,[1] usually in consequence of some disease within the joint itself, occasionally as the result of great force in the extraction of the head with forceps or after version. The accident may be recognized at the time of its occurrence by feeling the bones give way, or by actually hearing them snap. But it may not be detected until the woman complains of great pain in the symphysis, and of inability to sit up or walk when she rises from bed. Not infrequently rupture of the symphysis is followed by suppuration of the joint. The accident must be treated by a firm binder around the hips, and sand-bags such as are used after a symphysiotomy, and by keeping the patient in bed four or five weeks. Suturing the ends of the bones with silver wire may be required. If the joint suppurates, it should be opened as early as possible and should be well drained. The prognosis of the injury is not serious. Recovery may be expected as a rule, without impairment of locomotion or other disagreeable consequences, if the symphysis alone is injured.

Rupture of the sacro-iliac joints has the same causes as rupture of the symphysis, and is often associated with it. Inflammation and suppuration in these joints often follow their injury. The symptoms in the puerperium are, great pain over the joints on attempting to walk, a feeling of insecurity in the pelvic bones, a wabbling gait, and loss of power in one or both lower limbs, with fever if the joints are inflamed or suppurate. The only treatment available is firm support of the pelvis by a pelvic binder, sand-bags

[1] Ahlfeld collected 100 cases, to which number Schauta added 14 (Müller's "Handbuch"). In 94,149 labors this accident occurred three times. About 130 cases are on record. Kayser, "Arch. f. Gyn.," Bd. lxx, H. 1, 1903.

alongside the pelvis, and extension to the lower limbs, or, best of all, the orthopedic surgeon's wire cuirass to immobilize the whole body. Prolonged rest in bed—six to twelve weeks—is necessary. In the case of suppuration of the joints, an incision into them from behind to evacuate the pus and to allow of drainage is indicated.

The mortality of injury to the sacro-iliac joints in labor has been thirty per cent.

Fracture of the Pelvic Bones.—This very rare accident in labor has usually been the result of the unskilful use of forceps. It is serious but not necessarily fatal. In a case reported by Studley,[1] of a fracture of the horizontal and of the descending ramus of the pubis, the woman recovered. Bird[2] also reports a recovery after a fracture of the horizontal ramus of the pubis before the application of forceps, and the author has seen one case with like result, in which forceps was applied and powerful traction was made.

Fracture of the sacrococcygeal joint, or of the coccyx, occurs very rarely in elderly primiparæ, in whom not only the sacrococcygeal joint, but the joints of the coccyx as well, are ankylosed. The fracture may be caused spontaneously by the expulsive efforts of the mother driving the presenting part down upon the pelvic floor ; but it is more commonly the result of the application of forceps and the forcible extraction of the head through the pelvic outlet. There are, in my experience, four types of injury to the coccyx in labor. In one there is an oblique fracture of a coccygeal vertebra involving a joint and resulting in painful mobility of the bone. In the second there is ankylosis of the two fragments with the lower one drawn in at a right angle, where it is out of the way and causes no inconvenience or discomfort except in a subsequent labor. In the third the lower fragment is ankylosed in a perpendicular position, causing great pain when the patient attempts to sit. In the fourth there is a strain, sprain, or an actual rupture of a coccygeal joint, with abnormal mobility and chronic inflammation of the intervertebral disc, with consequent hypertrophy and softening. This last form is by far the commonest. The injury often results in the condition known as coccygodynia after the completion of the puerperium.

Diastasis of the Abdominal Muscles.—Reference has been made to the escape of the uterus from the abdominal cavity between the recti muscles in labor. After delivery these muscles stand widely apart and threaten the woman with pendulous belly, ptosis of the abdominal viscera, and even with abdominal hernia when she rises from bed. Diastasis of the recti muscles is not uncommon after labor. It is usually observed without

[1] "American Journal of Obstetrics," April, 1879.
[2] "American Journal of Obstetrics," Jan., 1902.

precedent actual hernia of the parturient uterus. The condition can usually be corrected by a firm abdominal binder during puerperal convalescence or longer. If it is not, and does not yield to abdominal massage, electricity, and Swedish exercises, the operation of diminishing the width of the aponeurosis proposed by J. C. Webster[1] may be indicated.

Rupture of Some Part of the Respiratory Tract and Subcutaneous Emphysema.—During the straining of the second stage of labor, the larynx or trachea may be ruptured. This accident is followed by emphysema of the neck and face. The accident, if confined to the trachea or larynx, and resulting only in emphysema of the face, is not dangerous. If the emphysema is more extensive, however, or if there is a rupture of the pulmonary vesicles, with emphysema of subpleural and interlobular connective tissue, with embarrassment of heart and lungs, the prognosis is not so good. As soon as the nature of the injury is recognized the patient must be forbidden to strain, and should be delivered as quickly as possible by forceps or version.[2]

Fig. 504.—Median section of coccyx imbedded in paraffin, showing an oblique fracture running through the second vertebra. The vacant space between the lower end of the anterior fragment and the main body of the bone was filled with an exuberant mass of spongy bone-tissue that dropped off when the bone was taken out (author's case).

Sudden Death During or Directly After Labor.—The causes of this accident to the parturient woman are set down, as far as possible, in the order of their frequency.

Shock.—A few sudden deaths during and after labor may be explained by surgical shock, which is more likely to follow a serious accident, such as ruptured uterus in labor, but may result from the strain and suffering of parturition in weak, hyperesthetic individuals, without any serious complication.

Heart-failure is usually due to acute dilatation in the second stage of labor, but may be the result of advanced kidney disease, of fatty degeneration of the heart itself, of a fibroid patch in its walls, of rupture of an aneurysm, of myocarditis, and of a number of other conditions that might interfere with normal heart-action.

[1] "Journal of the American Medical Association," Dec. 22, 1900.

[2] Scheffelaar Klots has collected 40 cases, "Ztschr. f. Geb. u. Gyn.," Bd. xli, H. 3.

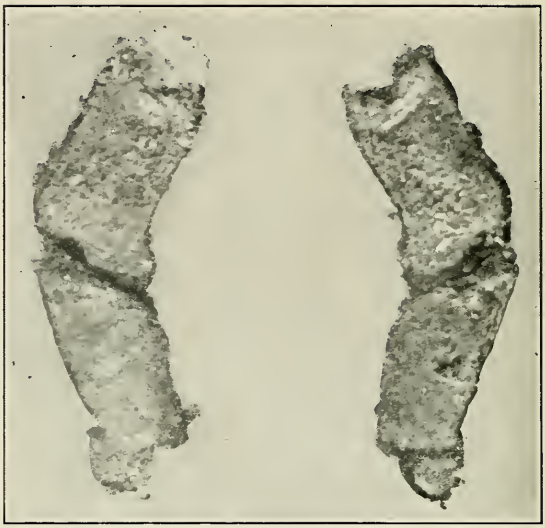


Fig. 505.—Coccyx ruptured in second joint by a forceps delivery. Ankylosis of all the other joints (author's case).

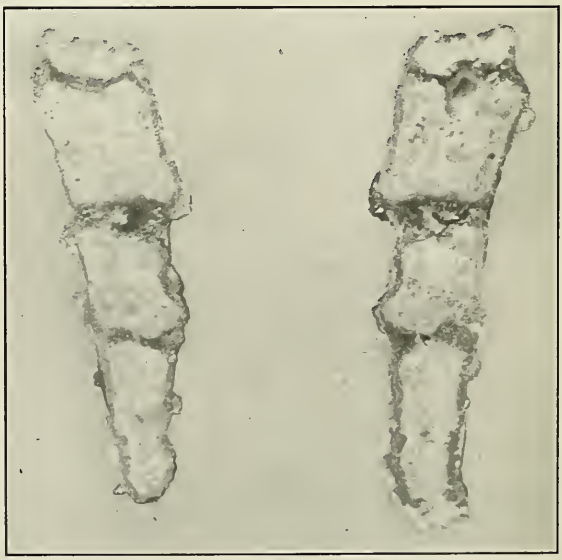


Fig. 506.—Coccyx ruptured in first joint by a fall on the ice in eighth month of pregnancy. Injury aggravated by labor (author's case).

In women with diseased and weak hearts so small a matter as an intra-uterine injection has caused heart-failure.

Accidents of Labor.—Any of the serious accidents of labor may produce death by shock or by hemorrhage, as accidental, unavoidable, or postpartum hemorrhage; rupture or inversion of the womb.

Rupture of Hematomata.—A rupture of a hematoma, external or internal, may kill a patient by shock or by hemorrhage. In a case under my care a hematoma in the outermost part of the left broad ligament, rupturing eighteen hours after delivery, caused death in a very short time by internal bleeding.

Syncope.—There is a disposition in many women after labor to faint, but even complete syncope at this time is rarely fatal. If it depends, however, upon hemorrhage, thromboses may form in the heart, or those in the uterine sinus may be prolonged, and embolism may result. Prolonged syncope, associated with air-hunger and other symptoms of profuse internal hemorrhage, is almost always fatal.

Embolism and Thrombosis of the Pulmonary Artery.—This may be the result of syncope, or may be caused by the detachment of an embolus from the pelvic blood-vessels. The embolus, it is claimed, may be a globule of air,[1] or may be fat from the pelvic connective tissue. The symptoms of the accident are: sudden shock, a rapid-running pulse, heart-failure, rapid respiration, air-hunger, followed usually in a few moments by death; but the accident is not invariably fatal. I have seen one well-marked case recover. The only treatment possible is stimulation, slight elevation of the body, and lowering of the head, with absolute quiet.

Profound Mental Impressions.—Profound emotion may cause a woman's death during or directly after labor. The following case was described to me by a friend who witnessed it. A widow, in good position, applied for treatment for abdominal tumor. She was told that she was pregnant, but she vehemently denied the possibility of her condition. A little later her physician was summoned to attend her in what he found to be labor. He told her again of her condition, but she again denied it, and throughout the whole of her labor she indignantly protested that it could not be so. Finally, when the child was delivered, it was held up before her as a proof that her physician was correct. She passed at once into a maniacal condition, crying out that the child was a tumor, that she had not been pregnant at all, and after a few minutes she died. A careful postmortem examination revealed no physical cause for her death.

[1] Since I saw my friend, Professor H. A. Hare, inject whole syringefuls of air into the jugular vein of a dog without detriment to the animal, I confess to a skepticism in regard to air-embolism as a cause of death in the child-bearing woman.

Other causes of sudden death during and after labor that have been reported are: a brain tumor, rupture of a gastric ulcer, acute purpura hæmorrhagica, rupture of peritoneal adhesions, rupture of the aorta, rupture of a cyst in the auricular septum of the heart, retro-peritoneal hemorrhage from the head of the pancreas,[1] and angina pectoris.

Effect of Maternal Death upon the Fetus.—The fetus rarely survives its mother's death more than a few minutes, and usually the death of mother and child is synchronous. An interesting case was reported to me by a surgeon on an American man-of-war in the harbor of Rio Janeiro during the revolution in Brazil. A pregnant woman, near term, was struck by a fragment of an exploding shell. She was killed immediately. She had scarcely fallen to the ground when a Brazilian surgeon, who was standing near, cut open her abdomen and uterus with a penknife, but the child was extracted dead. Tarnier reports an extraordinary case in which it appeared that the child lived for two hours after its mother's death. During the Commune in Paris the rioters fired upon the Maternity Hospital. A pregnant woman, sitting upon her bed in a ward, was shot through the head and instantly killed. After a while she was discovered dead, and Tarnier was summoned to do postmortem Cesarean section, as fetal heart-sounds were still heard. Beginning the operation with his assistants, the rioters fired upon the operators, and it was necessary to remove the woman to the cellar before the attempt could be repeated. After an interval of an hour and three-quarters, or more, the operation was at length performed, and a living child extracted from the mother's womb.

In case of death in a pregnant woman near term, the fetal heart-sounds should be listened for carefully, and, if they are heard, an immediate attempt should be made to extract the child. This can be done by postmortem Cesarean section, or, better, I think, by forced dilatation of the cervix, version, and rapid extraction. I have had one experience in such a case, in which the dilatation of the cervix and the extraction of the child presented no difficulties at all, and were completed in a very few moments. If the patient is seen *in articulo mortis*, it is unquestionably better to deliver her by forcible dilatation of the cervix and version rather than to await her death and then to perform a postmortem Cesarean section.

Postmortem Delivery.—There is reported from time to time the birth of a child in its mother's coffin, giving rise to the horrible suspicion that the pregnant woman had been buried alive, and had fallen into labor when she awoke from her trance and

[1] Van de Velde, "Jahresbericht," vol. xii, p. 764.

realized her dreadful position. These cases, however, may be explained by the accumulation of gas within the abdominal cavity due to decomposition, which so increases the intra-abdominal pressure as to drive the fetus out of the woman's body. Such cases are more common in hot climates, where decomposition progresses rapidly.[1]

Accidents to the Fetus.—Prolapse of the Cord.—The cord is said to be prolapsed when it presents with or slips beyond the presenting part.

Frequency.—According to Winckel, the frequency of prolapse of the funis varies in different clinics from 1 : 65 to 1 : 500. Churchill found it once in 245 labors; Christisen, once in 65; Meachem, once in 93; Bland, once in 1897 labors.

Causes.—The causes of prolapse of the cord are, in the first place, a lack of conformity of the presenting part with the shape and size of the pelvic inlet, as in a flat pelvis or a compound presentation, and with this condition an exaggerated length of the cord, placenta prævia, marginal insertion, hydramnios, sudden

Fig. 507.—Trendelenburg posture over a chair to guard a prolapsed cord from pressure and to facilitate its reposition (Dickinson).

rupture of the membranes and violent expulsion of the liquor amnii; delivery in the semirecumbent, sitting, or erect posture, and violent jolts or jars such as a parturient patient would experience during transportation to a hospital in an ambulance.

[1] Stumpf claims that postmortem deliveries may be due to a rigor mortis of the uterine muscles, "Monatschr. f. Geb. u. Gyn.," Bd. viii, p. 64.

The *diagnosis* should present no difficulty. There is nothing else in the cervical canal or vagina, during labor, which feels like the cord or should be mistaken for it. It is sometimes actually visible at the vulvar orifice, and may, in case of doubt, be pulled out and inspected. If the child is alive, the pulsating vessels in the cord may be felt. I was once called in consultation, however, by a young physician who believed that a coil of intestine had prolapsed into the vagina.

The *prognosis* for the child is grave. The mortality in general is more than fifty per cent. The child obviously dies of asphyxia from pressure upon the cord; hence the danger is twice as great in head presentations (sixty-four per cent.) as in breech presentations (thirty-two per cent.). The danger to the mother lies in the operative procedures which are often required for the reposition of the cord, such as version and rapid extraction.

Fig. 508.—Improvised repositor.

Treatment.—The cord should be replaced by manipulation with the woman in a knee-chest posture, or, better, the Trendelenburg posture—over the back of a chair. It is advisable to hook a loop of the cord over an extremity or the chin to prevent its prolapsing again, which is extremely likely. The whole hand must be inserted in the vagina, and perhaps within the lower uterine segment; so that anesthesia is usually required. While the anesthetic is administered, and while the physician makes his preparations for the reposition, the patient should be kept in the Trendelenburg posture, so as to guard the cord from fatal pressure. If the cord is satisfactorily replaced so that it will not come down again, forceps should be applied to the head to fix it firmly over the pelvic inlet. If the os is not sufficiently dilated to allow the application of forceps, a dilatable rubber bag (Barnes', Braun's, or Voorhees') should be inserted in the cervix or in the lower uterine segment and distended with water to prevent prolapse of the cord while the cervical canal is undergoing effacement and dilatation. If manipulation fails to replace the cord, podalic version should be performed without waste of time. The breech being firmly impacted in the pelvis, the case is managed as one of breech presentation—by delay until the os is well dilated and the cervix paralyzed, and then by rapid extraction. If the head is presenting and is engaged so that version is out of the question, the cord should be so disposed as to be least pressed upon (for example, opposite the left sacro-iliac junction in a left occipito-anterior position of a vertex presentation) and

the head rapidly extracted with forceps. In prolapse of the cord with a breech presentation, the cord should be replaced by manipulation in the Trendelenburg posture; a foot should be seized and brought down until the breech is firmly impacted in the pelvis.

The instrumental reposition of the cord is usually unsatisfactory and unnecessary. Manipulation accomplishes more than can be done by a repositor. Occasionally, however, it might be convenient to remember the device illustrated in figure 508. A loop of string or tape is tied double around the end of a stiff catheter or bougie. The free loop is caught over the cord and the end of the instrument which is carried high up into the uterine cavity. Should it be desirable to withdraw the instrument, it can be done without pulling the cord out with it.

Rupture of the Cord.—It has been shown by experiments that the healthy umbilical cord can stand a strain of 8¼ pounds on the average, the weakest 5½ pounds, and the strongest 15 pounds. It is obvious, therefore, that the weight of an ordinary fetus may be enough to rupture the cord, and it is almost certain to do so if the weight is increased by a drop or violent expulsion, and if the placenta remains attached. Hence, precipitate delivery in the erect posture is often accompanied by rupture of the cord usually at the umbilicus, although in one of my cases it tore off at the placental insertion. Spaeth and Budin have each reported a case of rupture of the cord while the woman was recumbent, and the latter has also reported a case in which the weight of the placenta, suddenly expelled and dropping the full length of the cord, snapped the latter in two. A ruptured cord usually does not bleed. If it is torn off at the umbilicus and the vessels bleed, they should be pulled out by a tenaculum and ligated, or, if this is impracticable, hare-lip pins should be inserted under the umbilicus and a figure-of-eight ligature applied.

The *treatment* of rupture of the umbilical cord is preventive. Labor in the erect posture should, of course, never be allowed, and a precipitate labor must be retarded; violent traction upon a coiled cord has ruptured it. It is better, in such cases, to cut the cord between ligatures and to extract the child quickly.

DYSTOCIA DUE TO DISEASE.

Convulsions.—Convulsions in the child-bearing woman may be defined as muscular spasms, with or without unconsciousness, occurring during pregnancy, parturition, or the puerperium.

Causes.—The convulsions may be due to eclampsia, hysteria, epilepsy, tumors of the brain, cysticercus,[1] and meningitis; to the

[1] Pestalozza, "Rivist. Critic. di Clinic. Medic.," 1900.

profound anemia following postpartum and other hemorrhages, and to apoplexy; or there may be an exaggeration of the nervous irritability characteristic of the child-bearing period, in consequence of which convulsions may arise from some trifling irritation, as that of an overdistended bladder, overloaded bowels, the introduction of the hand in performing version, the pressure of the head upon the perineum, and excessive after-pains. Puerperal convulsions, therefore, is a symptom indicative of a variety of pathological conditions.

Eclampsia is a name given to the most frequent variety of convulsions in the child-bearing woman, the result of kidney insufficiency and of a gestational toxemia. It is derived from a Greek word signifying to shine or flash out, and was conferred upon the condition on account of its sudden onset.[1]

Causes.—Since Lever's[2] discovery of the albuminuria usually preceding and accompanying eclampsia, kidney insufficiency has been regarded as the chief cause of eclampsia, but recent studies in the toxemia of pregnancy, while not diminishing the importance of imperfect elimination by the kidneys in the etiology of eclampsia, have established other factors in the causation of the disease. The several theories advocated at present start with the common assumption that the ovum or fetus is the source of toxins contaminating the maternal blood. What these toxins are and where they originate is still unknown. Kollmann[3] points out that the fibrin-forming elements of the blood are much increased in eclampsia. To these globulins, albuminous, large molecular bodies which furnish the excess of fibrin, is ascribed the toxicity of the maternal blood. There is much to support this view. Experimentally these substances have been demonstrated to be toxic, producing eclamptic symptoms. The negative results of cryoscopy in the urine of eclamptic patients indicate that there is an excretion of high atomic large molecular substances. Whether these substances, if they are the toxins of eclampsia, are derived from fetal metabolism or from the syncytium of the placenta is disputed. The author favors the former view for the following reasons: The toxemia of early pregnancy, which is probably due to the syncytial growth, differs in its clinical manifestations from the toxemia of the latter half of pregnancy; eliminative treatment and dietetic management to spare the kidneys and liver favorably influence the toxemia of the second half of pregnancy, but have no effect on the toxemia of the first half. The symptoms of the toxemia of the latter half of

[1] Hippocrates used the word *εχλαμψις* to designate a sudden rise of temperature. In the middle of the eighteenth century Boissier de Sauvages mistakenly applied the word to convulsions. The correct term would be eclactisma (*εχλαχτιζειν*, "to kick backward").

[2] "Guy's Hospital Reports," 1843.

[3] "Centralbl. f. Gyn.," 1897, No. 13.

pregnancy usually disappear with the death of the fetus; in multiple pregnancies albuminuria and eclampsia are ten times more frequent than in single pregnancies; in hydatidiform mole with its enormous overgrowth of syncytium eclampsia is rare; only two cases are recorded.

The toxins in the maternal blood are conveyed first to the liver, where they are converted into substances fit for elimination by the kidneys. If the liver fails in its functions or breaks down under the strain imposed upon it, the maternal blood contains toxic material irritating to the kidneys, the central nervous system, and the capillaries everywhere. The kidneys manifest the irritation of their capillaries and of their epithelium by the symptoms of parenchymatous nephritis. Clinically it appears that even if the hepatic function is imperfectly performed functionally active kidneys are competent to excrete the imperfectly oxidized excrementitious matters in the maternal blood. On the contrary, with impaired excretory power in the kidneys, a cumulative toxemia develops, ending in eclampsia. The following facts support this view: Hepatic degeneration, in some cases to the grade of acute yellow atrophy, is a constant condition in post-mortem examinations of eclamptic patients; a small proportion of cases display no kidney insufficiency prior to the eclampsia (10 to 16 per cent.). But some form of kidney disease is discovered post-mortem in the large majority of cases: In 18 out of 81 autopsies Herzfeld found the ureters compressed at the pelvic brim and dilated; in more than four-fifths of the cases eclampsia is preceded by albuminuria and other signs of kidney breakdown; as the kidney symptoms increase in severity eclampsia becomes more imminent; with improvement in the kidney symptoms the danger of eclampsia decreases; examinations of the urine show apparently an imperfect oxidization of the nitrogenous bodies excreted.[1]

Nicholson[2] has advanced the theory that the thyroid gland is the most important factor in furnishing an antibody for the toxins of pregnancy. Adequate hypertrophy and hypersecretion of the gland, which is the rule in pregnancy, safeguards a pregnant woman against toxemia; inadequate activity predisposes her to it.

In spite of the enormous amount of investigation to which this subject has been subjected in the last decade it is not yet possible to explain the etiology of eclampsia fully. The only facts on which there is agreement at present are that there is a toxin or toxins in the blood of the pregnant woman derived from the ovum or

[1] Massen, Ludwig, Savor, Whitney, Clapp; "Centralbl. f. Gyn.," 1895, No. 42; "Am. Gyn.," August, 1903.

[2] "Jour. of Obstet. and Gyn. of the Br. Empire," July, 1902; "Brit. Med. Journ.," Oct. 3, 1903.

fetus; that these substances affect mainly the liver and kidneys; that a breakdown of either of these organs results in a toxemia; that the accumulated toxins probably are intensely irritating to the capillaries; that either in consequence of an acute anemia of the brain, due to contraction of the capillaries or to a direct irritation of the central nervous system, convulsions appear.

From the clinical point of view it is a mistake to minimize the importance of the kidneys. The examination of the urine gives us the first premonitory signs of gestational toxemia in the latter half of pregnancy in more than four-fifths of the cases, and a treatment to avoid strain on the kidneys and to promote free urinary excretion is the only effective preventive treatment of eclampsia except the termination of pregnancy.

There must be taken into account also the extreme irritability of the child-bearing period, predisposing to convulsive outbreaks.[1] Five per cent. of eclamptic cases are reflex and not toxemic (Duhrssen).

The kidneys in pregnancy may become insufficient for the work of disposing of excrementitious matters from both maternal and fetal bodies, by reason of the kidney of pregnancy, of nephritis, of increased intra-abdominal pressure, or of direct pressure upon the ureters. It is important in practice to appreciate that the kidneys may be diseased and yet functionally sufficient, or that they may be healthy anatomically, but functionally insufficient for their double work.

Frequency.—Eclampsia occurs about once in 300 cases of pregnancy. It is most frequently seen in primiparæ, and more frequently in women illegitimately pregnant. It most often occurs during labor, is next in frequency during pregnancy, and occurs least frequently during the puerperium. It is ten times as frequent in multiple pregnancies as in single pregnancies, and occurs with greater frequency in climatic conditions which interfere with the free activity of the skin and throw extra work upon the kidneys.

Symptoms.—Eclampsia should always be feared if there are signs of kidney disease or disturbance during pregnancy, for diseased kidneys are more likely to be insufficient than healthy kidneys,[1] and in more than four-fifths of the cases gestational toxemia is first manifested by marked and increasing albuminuria. Increasing blood pressure is the most constant symptom of gestational toxemia in the latter half of pregnancy, and is an invariable precursor of eclampsia. The other symptoms of toxemia should also serve as danger signals; namely, digestive disturbances,

[1] Meyer-Wirz, "Klinische Studie ueber Eklampsie," "Arch. f. Gyn.," Bd. lxxi, H. 1.

rapidity of pulse, anomalies of vision, œdema, and headache. The prodromal symptoms of the attack itself are: Sharp pains in the head, epigastrium, or under the clavicle; muscæ volitantes, with failure of vision, great restlessness, or stupor. A few moments after the appearance of the prodromal symptoms the attack comes on with a stare; the pupils are at first contracted; the eyelids twitch, the eyeballs roll, the mouth is pulled to one side, the neck is then affected, and the head is pulled first toward one shoulder and then toward the other. The spasm finally spreads to the trunk and upper extremities; the arms are strongly flexed, the fingers are

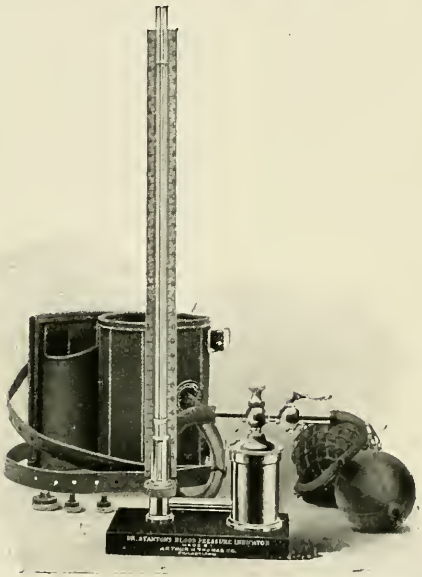


FIG. 509.—Stanton's apparatus for measuring blood pressure.

bent over the thumb, and the upper extremities work spasmodically to and from the median line in front of the chest. The spasm of the respiratory muscles with the closure of the teeth and lips give rise to a jerky sort of breathing with a characteristic sucking sound. The lower extremities are rarely affected, although the thighs may be flexed tonically upon the abdomen. Consciousness is lost during the convulsive attack and for some time afterward; with each returning fit the stupor deepens, until at length there is unbroken coma. The convulsion lasts for a minute or two. The temperature usually rises higher with each convulsion. The patient often has no recollection whatever of events during, preceding, and following the whole period of her convulsive attacks,

though she may have seemed to be perfectly conscious the greater part of the time.

The urine is almost always albuminous after the first or second convulsion; albuminuria precedes the convulsions in more than four-fifths of the cases. The percentage of urea and of most of the urine salts except the chlorids is not necessarily lowered, though the total excretion is diminished owing to a scanty secretion of urine sometimes to a complete anuria. The urine may contain methemoglobin and oxyhemoglobin as well as free blood, numerous casts, and desquamated cells.

Pathology.—The lesions of eclampsia are by no means confined to the kidney, in which, however, extensive degeneration of the epithelium or interstitial nephritis is almost invariably found. In 18 out of 81 autopsies Herzfeld found the ureters much dilated by compression at the pelvic brim.[1] In the liver, kidney, brain, and lungs are numerous thromboses of the small capillaries, extravasations, and necrotic areas. Emboli of liver cells are found in the important organs. There is degeneration of the myocardium. In the lungs there may be edema or pneumonia and infection from the inspiration of foreign material from the mouth. There are also in the lungs emboli of giant polynuclear cells which Schmorl attributes to the surface of the placental villi, having, indeed, demonstrated their exfoliation, absorption into the circulation from the intervillous blood spaces, and their passage through the heart to the lungs, where they are arrested because they are too large to pass the capillaries.[2] Schmorl attributes eclampsia to the exfoliation of these giant cells.[3]

The assertion that only 5 per cent. of women with diseased kidneys develop eclampsia is not strictly true; even if it were, the proportion of one in twenty contrasted with one in three hundred shows the influence of imperfect kidney action in the etiology of gestational toxemia and eclampsia. As a matter of fact, only a minority of patients with diseased kidneys go through pregnancy without some of the manifestations of toxemia.

Differential Diagnosis.—The convulsions of eclampsia must be distinguished from those of epilepsy, hysteria, brain disease, hemorrhage, or of some source of irritation within the body, as mentioned above. The distinction should be made without difficulty by an examination of the urine. If the patient is catheterized, and the urine is heated in a spoon over a gas-lamp flame, it will turn almost solid by the coagulation of albumin in it.

[1] "Centralbl. f. Gyn.," No. 40, 1901.

[2] Pels Lensden has found these giant cells in the lungs of non-eclamptic patients, "Ztsch. f. Geb. u. Gyn.," xxxvi, S. 1.

[3] "Pathologisch-Anatomische Untersuchungen über Puerperal-Eklampsie," Leipzig, 1893.

About sixteen per cent. of the cases of true eclampsia show no albuminuria before the convulsions appear, but in every case, after the second convulsion at least, the urine contains albumen, almost always in large quantities. Casts are present in abundance. The other conditions causing convulsions in the child-bearing woman have their distinctive signs that serve to make the differential diagnosis easy.

Prognosis.—In general practice it may be stated that the mortality of eclampsia is thirty per cent., but in different localities, and at different times, the mortality varies widely. For example, the mortality in nine lying-in hospitals in this country during a period of five years was 38.4 per cent. in 78 cases. The mortality of the Royal Maternity in Edinburgh has been 66.6 per cent. That of Guy's Charity, in London, averages 25 per cent. In 209 cases in the Maternité, in Paris, from 1850 to 1856, the mortality was 33 per cent. Winckel reports 92 cases, with 7 deaths—a mortality of 7.6 per cent. Veit reports more than 60 cases, with 2 deaths—a mortality of 3.3 per cent. In 46 cases in the Charité, in Berlin, there were 6 deaths, 2 of these being due to complications, so that the mortality of the eclamptic cases was 8.5 per cent. It is claimed that in Germany in general the mortality has been reduced to between 7 and 10 per cent., but in 80 cases in the University Maternity of Berlin, the death-rate was 21.25 per cent. In the Maternity Hospital of Christiana there were 160 cases from 1895–1904, with a mortality of 26 per cent. In 496 cases in Olshausen's clinic the mortality was 21.4 per cent.[1] In the Maternity of the University of Pennsylvania the mortality in 128 cases was 33 per cent., but, excluding the cases admitted in such bad condition that death ensued in less than twelve hours, the mortality is less than 13 per cent.

The causes of death may be edema of the brain, of the lungs, or of the larynx; apoplexy, asphyxia, exhaustion, heart-failure; thrombosis and embolism in important vessels, especially the pulmonary arteries, insufflation of foreign substances (food, blood) into the lungs, and bronchopneumonia, or an overwhelming accumulation of the poison of eclampsia in the system. In one of my patients there was gangrene of the lungs and in another purpura hemorrhagica of the most malignant type. The mortality is greatest during pregnancy and least in the puerperium. The greater the number of convulsions and the shorter the interval between them, the graver the outlook; but death may follow the first convulsion and recovery has been observed after sixty-nine.[2]

[1] "Ztschr. f. Geb. u. Gyn.," Bd. lviii.

[2] Lithgow, "Br. Med. Journ.," March 26, 1904.

Rapid pulse and high temperature are unfavorable symptoms. Nothing is so uncertain as the result of eclampsia. The physician should never relinquish hope of recovery until death actually occurs, but should not be too confident even in apparently favorable cases.

The mortality of the child, if eclampsia occurs during pregnancy or labor, is about 50 per cent.[1]

The following detailed statistics of 112 cases are taken from the records of the University Maternity :

Patients, 112. Ages, fifteen to forty-two.
Primiparæ, 84.
Multiparæ, 28; of whom four had two children; one, 3; three, 4; one, 5; two, 6; three, 8; and one, 10. The one with 8 had had eclampsia in last six pregnancies. The women with 3, 5, and 6 had had one attack before.
Multiple pregnancies = 3; all twins and two mothers died.
Premature cases, 29; one at 4½, one at 5, two at 6½, nine at 7, two at 7½, and four at 8 months.
Cases at term, 83.
Convulsions varied from 1 to 199 in number.
Urine.—Anuria in 3 cases. ℥vij in four days in one case. Albumin from $\frac{1}{10}$ to solid. Urea from 0.001 to 0.055 per cent. Albumin, trace till first convulsion and then solid, 10 cases. In one case convulsions appeared twelve hours after delivery; in another, four days after delivery.
Time of Convulsions :
Before delivery only = 41, of which 10 died.
After " " = 14, of which 8 died.
Before and after delivery = 15, of which 5 died.
Complications:
Mania, 4 cases (3 multiparæ, 5, 4, 8): 1 permanent; 1 lasted eight days; 1, four days; 1, seven days.
Blind, 3 cases.
Gangrene of lung, 1; died.
One woman was comatose seventy-eight hours, yet recovered.
Hemiplegia, 1 case; died.
Purpura hemorrhagica, 1; died.
Hyperpyrexia, 107°, 108°, 110°, 3 cases. Low temp., 94°, 1 case.
Albuminuric retinitis, 5 cases. Albuminuria persisted in 5 cases; cleared up in 42 cases.
Deaths, 29. Twelve hours or less after admission, 12; more than 12 hours, 11; died undelivered, 4; died from ether nephritis after recovery from eclampsia, 1.
Deaths in Primiparæ = 24 = 28.5 % } including all cases.
Deaths in Multiparæ = 5 = 18 % }
Total death-rate, 25 %; excluding cases brought in by the ambulance in a hopeless condition, 13 %.
Child. Thirty-five children still-born, including all premature cases. Excluding 15 cases under eight months = 20 dead, 37 alive (2 twins), 26.3 %.
Operations. Simple induction of labor with spontaneous delivery, 14 cases; 2 deaths.
Accouchement forcé.
Version, 9 = 4 deaths.
Forceps, 4.
Craniotomy, 2 = one death from ether nephritis after apparent recovery.
Bossi dilator and forceps, 4 = 2 deaths.
" " " version, 1 = 1 death.

[1] Enormous statistics of eclampsia in "Jour. Am. Med. Assoc.," Jan. 2, 1904, p. 67. Also Goedecke, "Zeitschr. f. Geb. u. Gyn.," Bd. xlv, S. 50; Glockner, "Arch. f. Gyn.," Bd. xxxvi, S. 171; Meyer-Wirz, "Arch. f. Gyn.," Bd. lxxi, H. 1

Venesection, 3 cases; all died.
Albuminuria. (*351 patients.*)
Quantity, decided trace to ½ by bulk in boiling.
Urea = 0.001 to 0.057.
Labor induced to avert eclampsia, 11; none developed convulsions.
Convulsions, 11; 2 died.
Multiple pregnancies: twins once.
Casts present, 26; mostly hyaline and granular.
Marked edema, 7; two of these women developed eclampsia.
Persistent vomiting, 7; all induced labor. See above.
Patients who had had eclampsia before but escaped under treatment, 40.

Treatment.—The preventive treatment of eclampsia has been in part referred to in the section upon the Management of Pregnancy, and under the head of Gestational Toxemia and of Kidney Diseases during Pregnancy. As already stated, routine examinations of the urine should be made every two weeks until the last month, and then weekly. If any abnormality is found or reported, such as a very high or low specific gravity, diminution in total quantity in the twenty-four hours, albumin or casts, or if the patient reports headache, disturbance of vision, edema, gastralgia, nausea, dyspepsia, palpitation of the heart, or a feeling of general malaise; if she presents an abnormal appearance, has a rapid pulse, coated tongue, foul breath, or a dry, harsh skin, with a sallow complexion, the total quantity of urine passed in the twenty-four hours should be collected daily and examined for albumin, urea, specific gravity, and casts. Whether the urinary examination is satisfactory or not, the patient presenting symptoms of a gestational toxemia should be put on a diet mainly of milk; meat, eggs, fish, and the stronger nitrogenous vegetables being excluded. A laxative at bedtime, copious draughts of water, and a diuretic should be prescribed.

The most valuable indication of the kidney condition is the presence or absence of albumin in the filtered urine. It is true that a small proportion of cases (less than a fifth) develop eclampsia without previous albuminuria, but in more than 80 per cent. albumin appears in the urine in the early stages of a gestational toxemia and gives timely warning of a threatened breakdown of the excretory organs and of an outbreak of eclampsia. Much importance was at one time attached to the excretion of urea. Normally, a pregnant woman should excrete 20 to 24 grams a day, or about 2 per cent. Careful examinations, however, of a number of women in the University Maternity, by Edsall, with control of the diet, showed such irregularity in urea excretion that its estimate gives the clinician little information of value. In the routine examinations in the hospital the urea elimination varies from 3 to 36 grams a day in women on the same diet, under the same conditions and equally well. If, however, there is persistently less than one per cent. of

urea in the urine, and less than 1200 c.c. a day is passed, especially if, at the same time, there is disturbed digestion and coated tongue, the case should at least be regarded with suspicion and precautionary dietetic and medicinal treatment should be ordered.

The best test for albumin is Purdey's, with acetic acid, ferrocyanide of potassium, and the centrifuge. The most convenient apparatus for estimating urea is Doremus'. If, in spite of milk diet, confinement to bed, purgation, diuresis, and diaphoresis, the albumin increases and the urea decreases, labor should be induced. It must be remembered, however, that the urea percentage is always below normal, and sometimes very low, on a milk diet, and that a woman with a high nitrogenous output may display a rapidly increasing toxemia with increasing albuminuria.

The treatment of the eclamptic convulsions themselves is best dealt with by considering, first, the different plans of treatment separately, with their results, so that their relative merits may appear plainly.

Anesthetization.—Chloroform is the only anesthetic to be employed. When this drug first came into general use it was regarded by many as a specific for eclampsia, and is so regarded by a few to-day. Series of 20, 12, and of 9 cases, treated by chloroform alone, have been reported without a death. Charpentier reports 63 cases treated by chloroform alone with 7 deaths—a mortality of 11 per cent. But, on the other hand, the mortality from this treatment in the Maternité was 50 per cent. The place of chloroform in the treatment of eclampsia is now settled. No one would rely on it alone; but every one is willing to admit its value as an adjunct to other treatment.

Diaphoresis and Catharsis.—Eclampsia is the result of some poisonous matter in the blood, and can not be cured until this poison is eliminated. The only emunctories available for quick and effectual action are those of the skin and bowels. No matter, therefore, what plan of medicinal treatment may be adopted, diaphoresis and catharsis must also be employed. The action of the skin may be excited by a hot wet-pack, by hot air or vapor, or by a hot bath. In private practice the hot wet-pack or the hot-air bath are the most practicable, and are to be recommended. A free sweat is conveniently and quickly produced by heating six or eight bricks on the kitchen stove, wrapping them in bath towels, putting them around the patient's lower limbs and trunk, pouring a pint or more of alcohol on them, and then covering bricks and patient with several blankets. There is nothing so effective, however, as the portable sweat cabinet (Fig. 510), with which every physician who may see cases of eclampsia should be provided. The injection of normal salt solution into the sub-

cutaneous cellular tissue or under the breasts is an indispensable aid to free elimination by the skin. It seems literally to wash the blood of its impurities. If, however, the patient does not sweat or purge freely, the injection of salt solution predisposes to pulmonary edema. Free catharsis is produced best by the use of croton oil, which may be administered in drop doses with a little sweet oil upon the back of the tongue, and can, therefore, be given to a woman whether she is able to swallow or not. Elaterium in quarter-grain tablets may be administered in the same manner. It is often advisable to wash out the stomach; if this is done, an ounce or more of castor oil with a couple of drops of croton oil

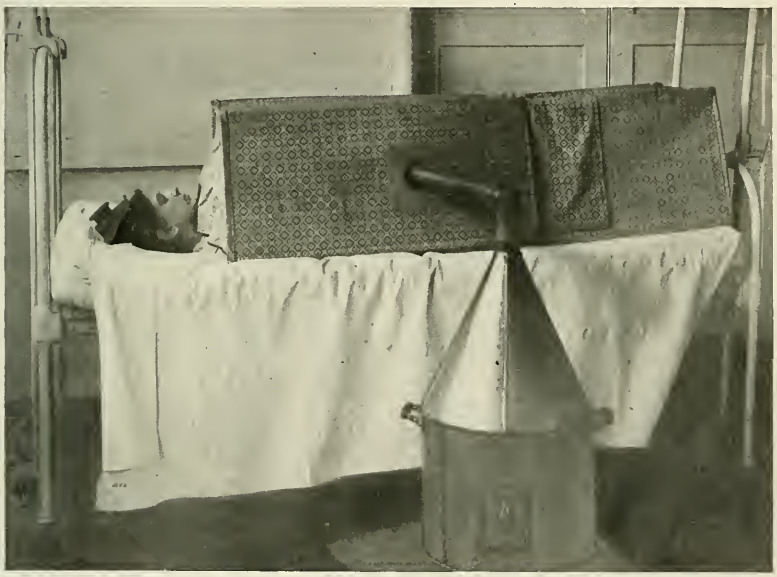


Fig. 510.—Portable sweat cabinet.

may be put into the stomach through the stomach-pump. If the patient can swallow, a concentrated solution of Epsom salts is administered, in dessertspoonful doses, every fifteen minutes until free catharsis begins. For the stupor that often succeeds convulsions, and in which the patient frequently dies from toxemia, the use of Epsom salts is most suitable.

Venesection.—Phlebotomy is at present somewhat in disfavor. The reaction against the indiscriminate use of the lancet has, however, gone too far. While bleeding in every case of eclampsia is unwise, there are many cases in which it rescues women from impending danger of pulmonary edema and apoplexy. Physicians in the country, who have to deal with strong, full-blooded people,

are obliged, in the treatment of pneumonia as a routine practice, to use the lancet. In the same class of people blood-letting in eclampsia is equally necessary. In a report of fifteen cases in which bleeding seems to have been the only thing done, there was but one death. In appropriate cases the venesection should be done in time, and not, as sometimes recommended, only when symptoms of pulmonary edema appear. The measure is preventive of this accident, not curative.

Morphin.—Older statistics of the morphin treatment for eclampsia show a death-rate of 57 per cent. (Winckel), but Veit in more than 60 cases had only 2 deaths—a mortality of 3.3 per cent., the lowest death-rate yet obtained by any plan of treatment. This result is obtained by giving very large doses of the drug. Veit has injected one-half grain in each convulsive seizure, and has administered as much as three grains in four to seven hours, and four and one-half grains in twenty-four hours. This treatment is permissible if, as is usually the case in eclampsia, there is parenchymatous nephritis. In interstitial nephritis it would almost surely kill the patient.[1] It also antagonizes the eliminative treatment. For these reasons the author does not recommend it routinely.

Chloral has many advocates. Charpentier prefers it above all others, and presents statistics to justify the preference (114 cases, mortality 3½ per cent.). Winckel recommends it highly, and by its use has saved 85 out of 92 cases. This drug, too, must be given in large doses to be effective. Thirty to sixty grains should be administered by enema at a dose, and as much as three drams may be given in the twenty-four hours, or even more in bad cases.

Veratrum Viride.—The use of this drug is the American treatment of eclampsia. For the past thirty-five years it has been extensively employed in different parts of the country. Fearn, in 1871, reported 11 cases of his own and 2 cases from the practice of professional friends treated with very large doses of veratrum viride. None of the women died of the convulsions, but one succumbed later to puerperal sepsis. Rushmore has collected 85 cases of eclampsia treated with veratrum viride, with 20 deaths—a mortality of 23½ per cent. Jewett reported to the American Gynecological Society, in 1887, 22 cases of eclampsia treated with veratrum viride. Four of the women died of the convulsions—a mortality of 18 per cent. In 50 cases of eclampsia collected by Trimble, veratrum gave much the best results. In 26 cases treated by this drug there were 3 deaths, while in the remaining 24 cases there were 6 deaths—a mor-

[1] Meyer-Wirz found interstitial nephritis three times in thirty-five autopsies. "Arch. f. Gyn.," Bd. lxxi, H. 1.

tality, respectively, of 11.5 and 25 per cent. Mangiagalli reports 18 cases treated with veratrum viride with one death, not from the disease.[1] I have used it in more than 100 cases in the last twenty years and believe in its efficiency.

Remedies to Reduce Blood Pressure.—A rise of blood pressure always precedes eclampsia, and increases with the severity of the attack. A fall in blood pressure, with amelioration of the other symptoms, is the most favorable prognostic sign, but with aggravation of the other symptoms indicates impending death. The most successful remedial measures are those which reduce blood pressure most quickly and most effectually; namely: Puncture of the membranes; sweating; purgation; venesection, veratrum viride, and nitroglycerin.

The remedial measures detailed above comprise all that should be seriously considered. The treatment of eclampsia by antemortem Cesarean section, proposed first by Halbertsma, has not been successful, and can scarcely be regarded as justifiable. Caffein, oxygen, and nitrite of amyl have not been used often enough to justify an opinion of their worth, and this judgment must be passed also on a number of other drugs recommended from time to time. Pilocarpin, as a routine treatment, is simply mentioned to be condemned. There is no other treatment of eclampsia that gives so high a mortality. In the Edinburgh Maternity, where this drug was employed for a time, the mortality was 66.6 per cent. Pilocarpin strongly predisposes to pulmonary edema, which explains the high mortality. Occasionally, however, if wet or dry heat fails to make the patient sweat, a single hypodermic injection of $\frac{1}{6}$ grain is of great service. This drug is least dangerous in eclampsia after delivery. Thyroid extract, recommended by Nicholson as a vasomotor dilator, is receiving a trial. It is often difficult to administer it if the woman can not swallow. *Parathyroid extract* promises more satisfactory results than thyroid extract, and should be systematically tested.[2] Lumbar puncture,[3] decapsulation of the kidneys, and nephrotomy have been tried for eclampsia. If there were any way of recognizing the necessity for these procedures in occasional cases they would be justified once in a while; but there is not, and if resorted to routinely they would do more harm than good.

In eclampsia during parturition the *obstetrical treatment* must receive consideration. As a rule, it is better to avoid inter-

[1] "Ann. di Ost. e Gin.," No. 7, 1900.

[2] See Zanprogini, "La Clinic. Ostet.," "Riv. di Ostet.," etc., anno 7, 1905; also, "La Clinic. Ostet.," January, 1906; Vicarelli, "Giorn. d. R. Accad. di Med. di Torino," 1906. I am using it in 1-grain doses every three to four hours; if necessary, given through the stomach-tube.

[3] "Lumbar Puncture for Eclampsia," "Zentralbl. f. Gyn.," No. 45, 1904; "Nephrotomie," ibid.

ference with the progress of labor, unless the os is fairly well dilated. Should eclampsia come on before labor begins at all, or in its earlier stages, the physician's attention should be confined to combating the convulsions. Having succeeded in subduing them, attention may be directed to the delivery of the patient. It is usual to find that the os has dilated rapidly during the con-

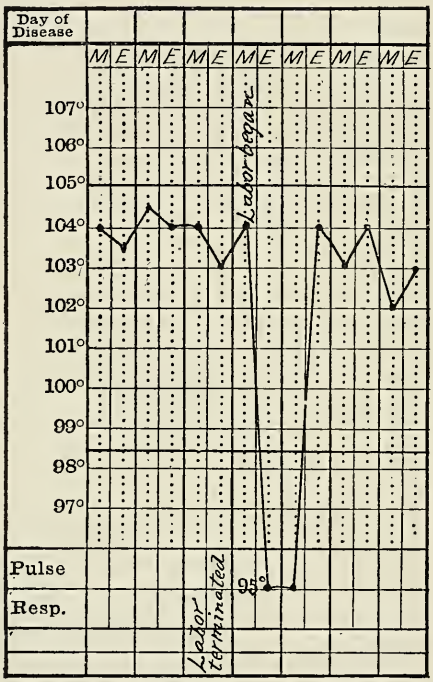


Fig. 511.—Temperature-chart of a patient falling in labor in the midst of an attack of typhoid fever (author's case).

vulsive attacks or in consequence of vigorous eliminative treatment. It has been recommended to resort to forced delivery (*accouchement forcé*) in all cases of eclampsia during labor, resorting to deep multiple incisions, if necessary, according to Dührssen's plan, to vaginal Cesarean section, or to instrumental dilatation by Bossi's or other branched dilators. Zweifel's statistics show, it is claimed, a mortality of only 15 per cent. in 223 cases treated by accouchement forcé as contrasted with a mortality of 32.6 from the expectant plan. Abdominal Cesarean section has been performed in 40 cases with 21 maternal and 18 fetal deaths.[1] Olshausen in

[1] Hillmann, Sectio Cæsarea bei Eklampsie, "Monatschr. f. Geb. u. Gyn.," Bd. x.

250 cases of eclampsia has performed three Cesarean sections with one death.[1] It seems logical to evacuate the uterus as the first step in the treatment of eclampsia. The ovum or fetus is the source of the toxemia; many statistics show a less mortality after labor than before and it is quite a frequent experience to witness a cessation of the convulsions as soon as the child is expelled, but the necessary operation for the delivery of the woman distracts one's attention from the treatment of the convulsions, and adds for the time being a violent source of irritation to the already highly wrought nervous system. Eclamptic patients are particularly liable to fatal shock from violent delivery or operative measures of any kind. Moreover, by waiting for a brief period, during which energetic treatment may be directed to the convulsive attacks, sufficient dilatation of the os is almost always secured naturally to permit the delivery of the woman without excessive violence or without too much loss of time. Puncture of the membranes hastens spontaneous dilatation and lowers the blood-pressure more quickly and effectually than anything short of actual delivery; hence, I resort to it routinely. As soon as the os is dilated beyond the size of a dollar, delivery may be hastened with advantage by applying forceps if the head is engaged in the pelvis, or by performing version and extraction by the feet if the head is not yet engaged, or if the breech presents. In eclampsia gravidarum labor may be induced after convulsions cease and the toxemic symptoms abate, or the uterus may be emptied if the patient fails to respond to treatment after a reasonable length of time. In more than 200 cases under my observation I have given both methods an extensive trial. No doubt remains in my mind that much the lowest mortality is secured by avoiding any form of accouchement forcé.

It may be useful to the student to have a scheme of treatment for the average case of eclampsia that he can put into effect without delay or confusion from considering the relative merits of the different plans just detailed. The following plan should be successful in the majority of cases: During the attack itself administer chloroform. As soon as the attack has passed off, inject under the skin fifteen drops of the fluidextract of veratrum viride, and administer by the bowel a dram of chloral in solution. Place upon the back of the tongue two drops of croton oil diluted with a little sweet oil. Or, if practicable, wash out the stomach and pour into the stomach-pump 2 ounces of castor oil with 2 drops of croton oil. Give a thorough sweat for thirty minutes in the portable cabinet every four hours. Ice should be applied to

[1] "Geb. Ges. zu Berlin," Nov. 24, 1899.

the head while heat is applied to the body. Inject by gravity under the breast or breasts a pint or more of normal salt solution, or, if the apparatus for subcutaneous injection is not at hand, inject several quarts of the solution by gravity into the bowel. The sweats and salt solution injections should be alternated every four to six hours. If convulsions recur, nitroglycerin, gr. $\frac{1}{100}$, may be given every four hours. If the face is congested and swollen, and the pulse remains full and bounding, venesection should be resorted to, withdrawing sufficient blood from the veins to reduce the tension of the pulse. Chloral may be repeated in the course of the attack two or three times, if the convulsions persist and are violent. If the face is pale and the pulse rapid and weak, stimulation may be required in the shape of digitalis, strychnin, nitroglycerin, brandy, ether, or ammonia hypodermatically. If the convulsions cease and the patient lies in a stupor, but can be aroused somewhat and is able to swallow, concentrated solution of Epsom salts, in dessertspoonful doses, should be given every fifteen or thirty minutes until free catharsis is established. If pulmonary congestion and edema develop, wet or dry cups should be applied over the chest. If the breathing is stertorous, the face cyanosed and swollen, wet cups or leeches should be applied to the back of the neck and behind the ears.

Usually the kidneys recover after eclampsia, but often a true nephritis persists or there is kidney breakdown in subsequent pregnancies. One of my patients had albuminuria and convulsions in five successive pregnancies, another in six. A woman who recovers from eclampsia should be watched for months and urinary examinations should be made at intervals for years. In subsequent pregnancies dietetic precautions should be insisted upon.

Shock.—The strain of labor in a weak woman, some of the accidents of parturition, or even forcible attempts to expel the placenta, may occasion shock after delivery, with lowered temperature, leaking skin, and a running, rapid pulse. Cases of this sort have been reported from compression of the left ovary in attempts to expel the placenta by Credé's method, the womb being turned upon the cervix so that the left side looks forward, and the ovary is grasped between the thumb and the uterine wall, when the hand is placed on the fundus of the womb in the effort of expression. The condition calls for the ordinary treatment of shock—heat externally and stimulants hypodermatically.

Typhoid fever, pneumonia, and other adynamic diseases may occur in pregnant women, and in the majority of cases occasion premature delivery. In typhoid fever this occurs in sixty-five per cent. of the cases, and in pneumonia the proportion is

quite as large. The advent of labor in the midst of these diseases is usually disastrous to the patient. Profound shock is often developed; the temperature falls abnormally low, even to 95° F., and the heart-action may be extremely weak. Active stimulation should be employed during the first stage of labor, and, as soon as the os is sufficiently dilated, the child should be artificially extracted as rapidly as possible without serious injury to the mother, in order to save her the strain of voluntary muscular effort in the second stage.

Valvular Disease of the Heart.—Mitral disease is the most serious. Certain statistics show a mortality as high as fifty-three per cent. As pregnancy advances the heart becomes more and more embarrassed, and respiration more labored. The most dangerous period, however, is just after the expulsion of the child, when the circulation is much disordered and an extra quantity of blood is thrown back upon the heart. It has been noticed that when the discharge of blood from the vagina is profuse, cardiac failure rarely occurs. This clinical observation points to the most successful treatment in cases of threatened heart-failure,—namely, venesection,—with the removal of from eight to sixteen ounces of blood, if there is not much blood lost from the parturient tract after labor. Nitrite of amyl and nitroglycerin are the most valuable stimulants to employ during labor and directly after its completion. Digitalis should be administered hypodermatically during the first stage in large doses, and as soon as it is possible to insert the forceps through the os, or to grasp the child's feet if the head is not engaged, the infant should be rapidly and, if necessary, forcibly extracted without anesthesia. Deep incisions of the cervix are of the greatest value in cutting short the duration of labor and in lessening the force required in the artificial delivery of the child. With this plan of treatment the mortality of heart disease in labor will be much reduced. It has been my fortune not to lose a case, although charged with the care of a number, some of which were of the most serious character.

PART V.

PATHOLOGY OF THE PUERPERIUM.

CHAPTER I.

Abnormalities in the Involution of the Uterus after Child-birth.

An abnormal course in the return of the uterus from the post-partum condition to the ordinary dimensions and weight of a non-gravid womb may manifest itself by excess or by deficiency; there may be superinvolution or subinvolution.

Superinvolution is an abnormal prolongation or an exaggeration of the process by which the gravid womb returns, after delivery, to the dimensions of a healthy non-pregnant uterus. It is in consequence reduced to a size much smaller than normal.

Trommel detected superinvolution in 29 out of 3000 cases; Simpson[1] saw it in 22 out of 1300 cases; Sinclair,[2] in measuring 108 uteri after childbirth, found in 22 instances a uterine cavity of less than $2\frac{1}{4}$ in. (5.7 cm.), and Fordyce Barker[3] has declared that he sees from 1 to 3 cases every year, and that in his opinion superinvolution constitutes about 1 per cent. of uterine diseases. Hansen,[4] among 120 nursing women, found 2 with a uterine cavity below 6 cm. (5.6, 5.4 cm., or 2.2, 2.1 in.) respectively at the eighth and tenth week after delivery. Johnson[5] gives an account of 3 cases which occurred in his practice, and Simpson[6] refers to those described by Chiari, Chiarleoni, Jaquet, and Whitehead. A case[7] has been reported after abortion.

[1] A. R. Simpson, "Superinvolution of the Uterus," "Trans. Edinburgh Obstet. Soc.," 1882–'83, viii, p. 88.

[2] "Trans. Amer. Gyn. Soc.," vol. iv. This series of measurements, as well as others made later by Sinclair and Richardson ("Trans. Amer. Gyn. Soc.," vols. vi and vii), are sharply criticized by Hansen, who declares them to be in great part incorrect. The criticism is apparently merited.

[3] "Trans. Amer. Gyn. Soc.," viii, 1883; discussion on Dr. Johnson's paper.

[4] "Ueber die puerperale Verkleinerung des Uterus," "Zeitschr. f. Geburtsh. u. Gyn.," xiii, S. 16.

[5] "Superinvolution of the Uterus," "Trans. Amer. Gyn. Soc.," viii, 1886.

[6] *Loc. cit.* [7] C. M. Hansen, "Medical Record," Oct. 6, 1888.

The etiology of the condition is somewhat obscure. It has been ascribed to wasting diseases, as phthisis, cancer, etc.; to anemia from hemorrhage at a previous birth or miscarriage; to nervous derangements, as puerperal insanity or chorea; to over-lactation; to a rapid succession of labors; to local inflammations, especially those which attack the ovaries and abrogate their functions. The degree to which the superinvolution may occasionally progress is surprising. A. R. Simpson reports a case in which the uterine cavity measured but $\frac{1}{4}$ of an inch.

The **treatment** is the application to the uterus by a platinum intra-uterine electrode of galvanism, 10 to 12 milliampères, by the negative pole; slow and rapid interrupted Faradism for fifteen to twenty minutes every other day for six weeks.

Subinvolution may be described as an arrested or a retarded involution of the puerperal uterus.

Causes of Subinvolution.—Any condition which prevents a rapid diminution of the blood-supply to the puerperal uterus may be a cause of subinvolution. Any condition which interferes with the contraction of the uterus is a cause of subinvolution. It is necessary to make these two broad divisions in the etiology of subinvolution, for, although frequently interdependent, they are not rarely independent of each other. In point of frequency there should be placed first those causes which prevent the normal decrease of blood-supply to the uterus after labor. Prominent among these should stand hyperplasia of the endometrium.

Subinvolution by an excess of blood-supply may occasionally be traced to the presence of small fibroids, throughout the uterine wall. Other causes of subinvolution are lacerations of the cervix and peri-uterine inflammations; inflammations of the uterine body and of its lining membrane, usually the result of sepsis; retention within the uterus of placental fragments, shreds of membranes, placental or fibrinous polypi, and blood-clots; chronic constipation; displacements of the womb; premature getting up; premature resumption of sexual intercourse; and anything which interferes with the return of the venous blood to the heart, causing a passive congestion of the pelvic organs, as increased intra-abdominal pressure from abdominal tumors, certain diseases of the liver, and valvular disease of the heart.

Many examples of subinvolution by the mechanical prevention of perfect uterine contraction may be observed, as large intramural and submucous fibroids; unusually large masses of hypertrophied decidua that sometimes develop at the placental site; the retention within the uterus of considerable portions of the

placenta, or placentæ succenturiatæ; large blood-clots; the displacement of the uterus by a retroversion or flexion of the organ, or by an overfilled bladder; peritoneal adhesions from old or recent inflammatory attacks, involving the serous covering of the uterus and adjacent parts. One fact stands out clearly from an observation of such cases: The cause of subinvolution is always some local disturbance, and not a constitutional derangement. The puerperal state may be complicated by any of the acute or chronic febrile affections, without the slightest influence upon uterine involution.[1]

One exception, however, must be made to this general statement: nervous derangements do influence involution. A. R. Simpson rightly assigns to puerperal insanity a prominent rôle in the causation of superinvolution. On the other hand, a sudden mental shock, some powerful emotion, may temporarily arrest involution.

The **diagnosis** of subinvolution is easy. The fundus uteri should be a finger's breadth above the umbilicus on the first day of the puerperal state, higher than it is directly after birth; on the second day, at the level of the umbilicus; the third day, a little below; the fourth day, about the same; the fifth and sixth days, two fingers' breadth below the umbilicus; the seventh, eighth, and ninth days, three or four fingers' breadth above the symphysis pubis; the tenth, eleventh, and twelfth days, at the level of or a little below the pubes.[2] Hansen, by measurements of 120 nursing women from the tenth day until the third month after delivery, gives the following as the normal course of involution from the tenth day of the puerperium until the completion of the process:

	Average Intra-uterine Measurement.	Minimum.	Maximum.
Tenth day (114 measurements)	10.6 cm.	8 cm.	13.5 cm.
Fifteenth day (119 ")	9.9 "	8.3 "	11.5 "
Third week (95 ")	8.8 "	7.5 "	10.5 "
Fourth week (80 ")	8.0 "	7.0 "	9.3 "
Fifth week (64 ")	7.5 "	6.5 "	9.0 "
Sixth week (56 ")	7.1 "	6.2 "	9.1 "
Seventh week (40 ")	6.9 "	6.0 "	8.5 "
Eighth week (31 ")	6.7 "	5.6 "	8.5 "
Tenth week (22 ")	6.5 "	5.4 "	7.5 "
Twelfth week (15 ")	6.5 "	6.0 "	7.5 "

[1] Temesváry and Bäcker ("Studien auf dem Gebiet des Wochenbettes," "Archiv f. Gyn.," Bd. xxxiii, H. 3, S. 331, 1888) correctly state that fever favors the involution of the uterus.

[2] For an extensive bibliography of uterine measurements in the puerperal state see Schroeder's "Lehrbuch," 8th ed., 1884, p. 230, and Hansen, *loc. cit.*

In two-thirds of the cases Hansen found involution completed in six to ten weeks; in one-sixth, not until the last half of the third month or later; in again a sixth, within six weeks. The most rapid involution occupied four weeks. Any great deviation from the normal course may easily be detected by abdominal palpation, by combined examination, or by the use of a sound, while along with the arrest or retardation of involution is usually found a profuse lochial discharge. Ahlfeld[1] claims that free perspiration after labor is a valuable sign of firm uterine contraction in the early part of the puerperal state; when it fails to appear, he always looks for uterine relaxation.

Treatment is directed not to the symptom (subinvolution), but to its cause. Evidently, therefore, it varies greatly. If the subinvolution depends upon the retention of hypertrophied decidua, a curet promotes rapid involution more effectively than anything else. If placental fragments or membranes are retained *in utero*, they should be removed. If involution is retarded by the presence of fibroids, the administration of ergotin, strychnin, and quinin in pill form, and the application of a faradic current have given good results. The bladder should never be allowed to remain distended with urine nor the rectum with feces. Inflammation in or about the uterus must be combated by appropriate treatment. If the heart-valves are imperfect or the heart-muscle weak and the abdominal and pelvic veins are consequently engorged with blood, a heart-tonic, as digitalis or strophanthus, often assists involution. Charpentier has asserted that the routine administration of ergot in the puerperal state hastens involution. This sounds reasonable, but clinical experience has not borne out the statement.

Herman and Fowler[2] did find, in experimenting on two sets, of patients,—one, 58 in number, receiving an ergot mixture daily for a fortnight after labor; the other, 68 in number, receiving a single dose of ergot after labor,—that in the first set involution advanced more rapidly, but that there was no difference in the lochial discharge. Boxall[3] also declared himself in favor of the routine practice of giving ergot during the puerperium, asserting that in two series of cases, comprising each 100,—one treated without, the other with, ergot,—there were fewer blood-clots; they were more quickly discharged, and the after-pains were less frequent, of shorter duration and

[1] "Der Zusammenhang zwischen Schweisseruption postpartum und Uteruscontractionen," "Ber. u. Arbeit. a. d. Geburts. Gynäk. Klinik zu Marburg," 1885–86, Bd. iii, S. 81.

[2] "On the Effect of Ergot on the Involution of the Uterus," "British Med. Jour." 1888, i. 299.

[3] *Ibid.*

diminished intensity in the latter series. Dakin,[1] however, dissented from these views, and claimed, after testing the matter in practice, that the routine administration of ergot retarded the involution by at least twenty-four hours. Blanc[2] also declared that the administration of ergotin during the first five or ten days of the puerperal state has not a favorable influence upon involution, but seems to interfere with it to some extent. As it is doubtful, therefore, whether ergot does aid involution, as there are many obvious disadvantages connected with its routine administration in the puerperal state, the adoption of the practice is unwise, and is not to be recommended.

Puerperal anemia might not inaptly be called a subinvolution of the blood. After the first twenty-four hours of the puerperal state there begins a change in the constitution of the blood by which it is converted from the hydremia of pregnancy to the normal proportion of its constituent parts in the non-gravid woman. At the end of two weeks the process is so far complete that the blood is more nearly in a normal condition than it was during pregnancy.[3] Many causes, however, may disturb the recovery from the hydremia and leukocytosis of pregnancy. Illness of any kind during pregnancy, hemorrhage during labor,[4] nervous affections —as insanity or chorea—during the puerperal state, kidney disease, fevers, etc., may all induce puerperal anemia. The treatment of the condition must be governed by the circumstances of the individual case. The cause of the anemia being removed, the blood will improve, and the improvement may be accelerated by tonic drugs and good diet. After hemorrhages, beef-tea, animal soups, milk, and as nutritious a diet as the patient can bear, along with tonic medicines, hasten recovery. By the use of Blaud's pills I have seen the blood-corpuscles rise from less than three to nearly four and a half million per cubic millimeter, and the hemoglobin increase from forty to seventy-five per cent. in a few weeks. In some cases arsenic alone succeeds where iron fails. Osler[5] has reported an interesting case of the kind.

Treatment of the Injuries of Child-birth.—Slight cracks in the mucous membrane, small rents in the cervix, vaginal wall, and vagi-

[1] *Ibid.*

[2] "Ann. de Gynéc.," March, 1888.

[3] Meyer, "Untersuchungen über die Veränderung des Blutes in der Schwangerschaft," "Archiv f. Gyn.," Bd. xxxi, S. 145.

[4] It is extraordinary, however, to see how rapid occasionally is the recovery of puerperæ, even from severest hemorrhage. A loss of 2000 to 2500 grams (4.4 to 5.5 pounds) of blood is usually fatal to an adult, but Ahlfeld reports two cases in which, respectively, 2000 and 2500 grams of blood were lost without serious anemia afterward ("Ber. u. Arb. a. d. Geb. Gyn. Klinik zu Marburg").

[5] "Boston Med. and Surg. Journ.," 1888, p. 454.

nal outlet,—unavoidable occurrences in almost every labor,—either unite firmly or else are healed by granulation. Occasionally, very extensive injuries are repaired by natural processes. Perforations of the vaginal vault, fistulous openings into bladder and rectum, deep tears and perforations of the perineum, transverse rents and perforations of the labia, lacerations about the urethra,—all have been known to unite without interference. Winckel states that perineal tears, when left to themselves, will be found healed in two and a half to five weeks; by this he means that they are skinned over with mucous membrane. The underlying muscles do not reunite. Extensive injuries should be repaired, by sutures (p. 867). Rents in the vaginal mucous membrane not involving subjacent muscles and cervical tears do not always require this treatment, unless there is profuse hemorrhage. In fistulæ the result of sloughs after labor, if the opening is not too large, a cure can occasionally be effected by touching the edges of the fistula with a strong caustic, like nitric acid. To do this the diagnosis must be made early in the lying-in period, which, as a rule, is not difficult. The escape of feces and gas from the vagina, and a constant trickling of urine, point respectively to a rectovaginal or a genito-urinary fistula. It is necessary in the latter case to exclude the incontinence of urine due to paresis of the vesical sphincter, and the overflow of retention sometimes seen in the puerperal state. All doubt is cleared away by finding the anomalous opening between bladder or ureter and vagina or cervical canal. In abrasions and wounds along the parturient tract it is necessary occasionally to apply lint saturated with carbolized oil to prevent an acquired atresia of the birth-canal. If the abrasions and wounds are infected and covered with exudate they should be cauterized with nitrate of silver solution, ʒi–fʒj.

Edema of the external genitals, the result of injuries, pressure, or contusions during labor, gives rise to considerable pain and discomfort, which are best relieved by the application of cloths wrung out in hot sublimate solution, 1 : 4000. If the patient's skin is irritated by sublimate solutions, I use hot infusion of witch hazel.

Puerperal hemorrhage denotes profuse bleeding from any point along the genital tract of the female, occurring after the first day of the puerperium until involution of the uterus is completed—a period of about six weeks.

The causes of this accident are numerous. The treatment is governed in most cases by a knowledge of the cause. The causes are placed, as far as possible, in the order of their frequency.

Retained placenta and membranes usually cause hemorrhage during the puerperal state. The retention of the whole

placenta is not now a cause of puerperal hemorrhage, for no practitioner of the present day would allow it to remain within the uterus many hours after delivery. Toward the end of the eighteenth and in the beginning of the nineteenth century, however, it was not rare to find followers of William Hunter, who trusted altogether to nature to deliver the placenta, often with disastrous results. White[1] describes four cases of retained placenta, with fatal hemorrhage on the first, second, third, and fourth days.

The retention of placental fragments is by no means rare. A careful inspection of the placenta after delivery often shows a defect, and the missing piece must be sought and removed; but occasionally it is difficult or impossible to tell whether the placenta has come away entire; and if the retained portion is an accessory growth, there is nothing to indicate its existence in the appearance of the placenta proper. Stadfelt states that, in 70 postmortem examinations of puerperæ, placental fragments were found in 7, varying from the size of a hazel-nut to that of an egg. Clinical observation alone makes this complication of the puerperal state appear more rare. Of 2960 births in the Frauenklinik at Munich, from 1884 to 1887, there were reported 9 cases of retained placental fragments.[2] It is possible, however, that small portions of placental tissue might escape unnoticed in the lochial discharge, or else by their disintegration form a part of the discharge. The retention of placental tissue does not always cause hemorrhage. I have seen a placenta succenturiata expelled on the second day of the puerperal state without any previous bleeding, the whole placenta left *in utero* for twenty-four hours without hemorrhage, and a very large piece of the placenta discharged four days after a premature birth, very fetid, but with no bleeding. In the 9 cases reported by Martini there was a prolongation of the bloody lochia in 1, a severe hemorrhage in 2; in 6 there was no excessive loss of blood.

The cause of the retention of placental fragments is either some abnormal form of placenta (marginata, multiloba, succenturiata, etc.), an abnormal adhesion to the uterine wall, or too forcible or premature efforts at extraction or expression.[3]

Retention of the membranes after labor is of frequent occur-

[1] "A Treatise on the Management of Pregnant or Lying-in Women," Worcester, Mass., 1793, p. 215.

[2] Martini, "Ueber das Zurückbleiben von Eihaut u. Placentarresten bei vor- u. rechtzeit. Geburt," "München. med. Wochenschr.," 1888, p. 653.

[3] Ahlfeld in 996 deliveries saw only 4 cases of puerperal hemorrhage. He attributes the freedom from this accident in his clinic to his conservative management of the third stage of labor. He insists upon waiting one and a half hours before expressing the placenta ("Ber. u. Arbeiten," Marburg, Bd. iii).

rence. Martini reports 71 cases out of 2960 births.[1] Reihlen[2] found a retention of some portion of the chorion in 152 out of 3534 labor cases (4.3 per cent.). Another investigation gave 5.1 per cent. from an analysis of 11,381 births. Credé[3] reports 91 cases of retained chorion in 2000 births.

Membranes retained *in utero* may give rise to septic infection; whether or not they are a cause of puerperal hemorrhage is still a disputed question. Credé[4] believes that retention of the chorion is not at all dangerous Olshausen declares that the retention of the chorion never justifies interference to extract it.[5] Reihlen[6] says that he never saw hemorrhage as a result of retained chorion. Schroeder[7] asserts that retained amnion and chorion practically never cause bleeding, even when retained *in toto*. On the other hand, Winckel[8] and Hegar[9] have shown that retained membranes could give rise to puerperal hemorrhage, as well as to septicemia. Martini reports 28 cases of retained chorion in which there was no fever—that is, no pathological condition, as uterine inflammation, decomposition of thrombi, etc.—to account for bleeding, and yet among these cases there were two severe hemorrhages, eight of minor grade, and six times a prolongation of the bloody lochia.

Retention of hypertrophied and angiomatous decidua is an etiological factor in puerperal hemorrhage. If the decidua is hypertrophied during pregnancy, the amount of tissue retained may be considerable. The mass may act as a foreign body within the uterine cavity, preventing firm contraction, and so predisposing to hemorrhage; or else, adhering to the uterine wall, it may attract an unnecessary amount of blood to the whole organ, with the same result. Even a small portion of deciduous membrane, as well as shreds of adherent chorion and amnion, or placental fragments, may form the foundation of polypoid tumors reaching occasionally considerable size, composed chiefly of firmly clotted blood or fibrin. The growth of these bodies is like stalactite formations on stone. The same thing occurs in different shape when the placental site is left unusually rough and vascular. The blood oozing from the sinuses may deposit successive layers of fibrin until quite a thick mass is formed.

[1] *Loc. cit.*

[2] "Zur Frage der Behandlung der Chorion-Retention," "Archiv f. Gyn.," Bd. xxxi, S. 56.

[3] "Archiv f. Gyn.," Bd. xvii, S. 278. [4] *Loc. cit.*

[5] "Klin. Beitr. zur Gyn. u. Geburtsh.," 1884, S. 146.

[6] *Loc. cit.* [7] "Lehrbuch," 10. Aufl., 797.

[8] "Berichte u. Studien," 1874–79; "Path. u. Therap. des Wochenbettes."

[9] "Path. u. Therap. der Placentar-Retention," 1862.

Prognosis and Treatment.—The fact that a portion of the ovum has been retained *in utero* is usually easy to discover. A careful examination of the secundines after labor enables one to detect missing parts, which must have remained behind in the genital tract. It is not wise, as a rule, to invade the internal genitalia in order to remove small shreds of amnion and chorion; if, however, a greater part of these membranes has been retained, it is advisable to remove it. The diagnosis of retained placenta is, as a rule, easy. When the whole organ remains *in utero*, the cord dangling from the external genitals points clearly enough to the condition. If one or more cotyledons remain behind, their absence may be noted from the placenta after its delivery. Occasionally, the diagnosis is more difficult, even if the whole placenta is retained. I recall a case in which a woman was delivered on her feet; the child dropped to the floor, the cord was dragged off from the fetal surface of the placenta, and the latter remained behind in the uterus; it was tightly adherent to the uterine wall, and its discovery, with no cord to guide one, was by no means an easy matter. It was finally peeled off and extracted, the woman meanwhile bleeding furiously.

Cotyledons torn off the periphery of the placenta may easily go undetected, and in certain roughly lobulated placentæ it is very difficult to be sure that no placental tissue has remained behind.[1] If the medical attendant suspects the retention of placental masses after labor, he must attempt their removal. This is usually not difficult. The hand,—the only trustworthy instrument under the circumstances,—covered by a sterile rubber glove, is inserted into the uterine cavity, the placental substance is felt for, caught by the fingers, and removed; if the placenta is adherent, the tip of the finger must be gently inserted, wherever most practicable, under the edge, and the whole organ gradually peeled off. If the uterine muscle is too firmly contracted to allow the introduction of the hand, the resistance must be overcome by firm, gradual pressure, first inserting one finger, then two, and so on until dilatation is effected. To accomplish the dilatation it is often necessary to administer an anesthetic.

If puerperal hemorrhage occurs, the presence of membranes or placental fragments within the uterus should be suspected, and their removal should be attempted unless some other condition is clearly seen to be the cause of the bleeding. To reach the uterine cavity after involution and retraction have made some progress, it is often necessary to dilate the cervical canal.

[1] "Zur Frage der Behandlung der Placentar-Retention," etc., "Zeitschr. f. Geburtsh.," xvi, pp. 292, 302.

Hegar's bougies will be found the safest and most convenient instruments for the purpose. Branched dilators, unless used with the greatest care, are dangerous in the puerperal womb. Not rarely, however, the cervical canal remains patulous in consequence of a foreign body *in utero;* in this case access to the retained mass and its removal are easy.

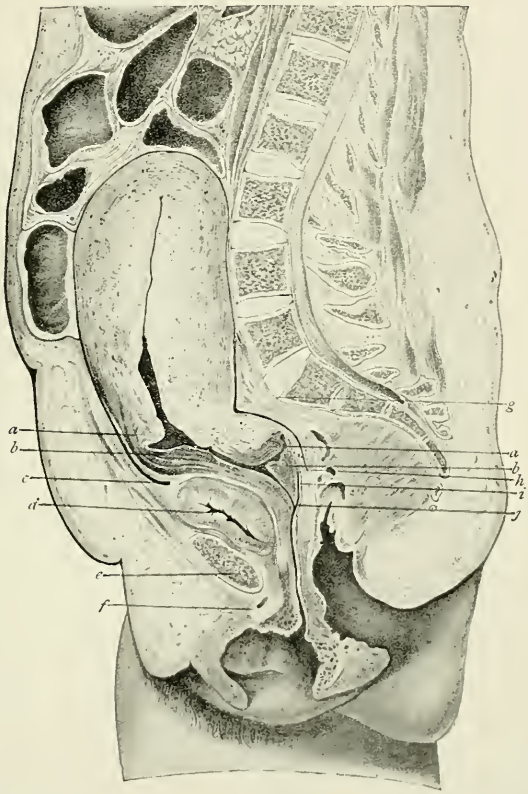


Fig. 512.—Stratz's section of a primipara, who died from hemorrhage with fatty heart within an hour after delivery: *a*, *a*, Contraction-ring; *b*, *b*, os internum; *c*, uterovesical reflection of peritoneum; *d*, bladder; *e*, symphysis pubis; *f*, urethra; *g*, promontory of sacrum; *h*, pouch of Douglas; *i*, posterior fornix; *j*, os externum.

Displacements of the Uterus.—The dislocation of the puerperal uterus often manifests itself in puerperal hemorrhage. Inversion, prolapse, displacements forward and backward and upward by a distended bladder, are all likely to be followed by profuse bloody lochia, if not by an active hemorrhage. Inversion and prolapse have already been considered; retroversion, retroflexion, and anteflexion are noticed here.

Hemorrhage is likely to occur in these displacements as a result of the passive congestion always associated with them, due to interference with the venous circulation; or the bleeding may be the consequence of the retention of blood within the uterine cavity, due to the mechanical interference with its escape; in the latter cases clots are formed, increasing gradually in size, often undergoing putrefaction, and acting not only as a foreign

Fig. 513.—Section of a primipara who died from sepsis five and a half days after delivery (Barbour).

body, preventing uterine contraction, and attracting by their irritating action an extra amount of blood to the uterus, but constituting as well a favorable nidus for the development of saprophytes, which may extend their operations to the thrombi at the placental site, disintegrating them.[1]

[1] Five cases of puerperal hemorrhage due to uterine displacement are reported by Gräfe in "Zeitschrift f. Geburtsh.," xii, 328.

The causes of uterine displacements in the puerperal state are the increased weight of the puerperal uterus, loss of tonicity, and relaxation of the uterine ligaments. They are, therefore, not infrequently associated with subinvolution. Backward displacements of the puerperal womb are often the result of a displacement antedating conception. They are frequently due also to a sudden physical effort soon after leaving the bed, especially if the woman has risen too early, before involution has advanced sufficiently far. Another common cause is the faulty application of a compress under the binder. Many nurses, unless they are properly directed, place a thick compress in direct relation with the anterior uterine wall, thus crowding the whole organ backward, instead of adjusting it over the fundus of the uterus, where it maintains a

Fig. 514.—Retroflexion of puerperal uterus (Schatz).

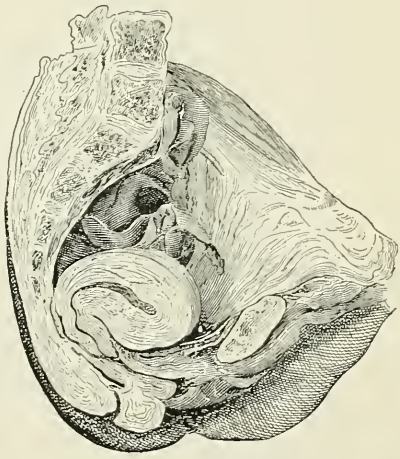


Fig. 515.—Frozen section of puerperal uterus in a state of anteflexion (Stratz).

condition of anteversion, and by constant pressure promotes firm contraction and rapid involution. Retroversion and retroflexion may persist after premature delivery, if these displacements existed during pregnancy. Neglect to empty the bladder at proper intervals may be a cause.

The *diagnosis* is easy if a careful physical exploration is made; and it should be an invariable rule to make a careful vaginal examination in every case of puerperal hemorrhage. It is not rare to find some portion of the ovum or blood-clots retained within the uterine cavity in consequence of the "stenosis by angulation" of the cervical canal. It is, therefore, not

sufficient to rest satisfied with the diagnosis of displacement in puerperal hemorrhage, but it is necessary to be sure that there is nothing retained within the uterus. It should be remembered that there may be no hemorrhage, but, for a time, suppression of the lochia, with displacements of the womb. Occasionally, if the dislocation occurs acutely, it may be associated with grave symptoms, as intense pain, a condition verging on shock, and high fever, these symptoms disappearing immediately upon the reposition of the womb.

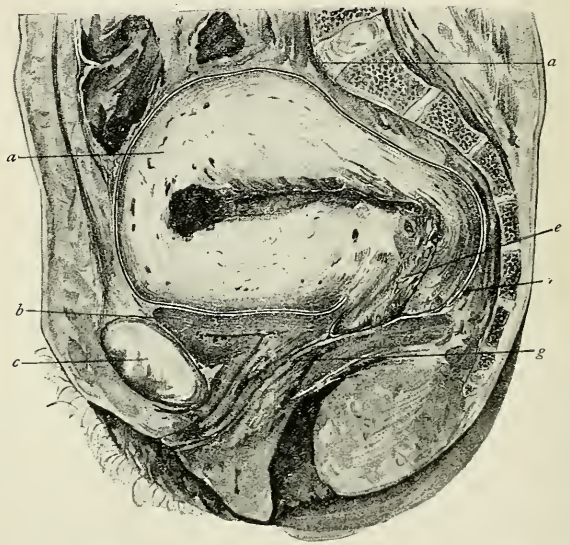


Fig. 516.—Anteflexion. Webster's section from a case of death from eclampsia about thirty-six hours after delivery: *a*, Fundus; *b*, bladder; *c*, symphysis pubis; *d*, promontory; *e*, cervix; *f*, pouch of Douglas; *g*, vagina.

The *treatment* of puerperal hemorrhage due to a displaced uterus is the rectification of the displacement, which is occasionally followed by the expulsion of blood-clots or remains of the ovum imprisoned within the uterus, and the true causes of the bleeding.[1] The uterus, restored to its natural position, may remain there. The knee-chest posture should be assumed twice a day. Mechanical supports (tampons and pessaries) are contraindicated before the sixth week.

[1] Strachan reports an interesting case of the kind associated with anteflexion. Six weeks after labor there was a severe hemorrhage; the uterus was straightened by upward pressure through the anterior vaginal vault. The following day a cotyledon of the placenta was discharged ("British Med. Jour.," 1886, i, 587).

Dislodgment and Disintegration of Clots at the Placental Site.—The thrombus formation in the large sinuses at the placental site plays a subordinate part in the prevention of hemorrhage after delivery. In consequence of sudden exertion, sitting upright in bed, or actually standing on the floor soon after labor, some of these clots, plugging up important vessels, might be dislodged. It is with this possibility in mind that every precaution should be taken to secure quiet and repose for the woman after labor. Disintegration of the clots at the placental site occurs occasionally in consequence of their invasion by micro-organisms. This is, therefore, one of the phenomena of puerperal infection. The bleeding that follows is, of all puerperal hemorrhages, by far the most dangerous.

Diagnosis.—The hemorrhage that follows displacement of thrombi at the placental site is startling in its suddenness, and alarming in the amount of blood lost. There need be nothing in the uterine cavity to account for it; the uterus may be in good position. The true condition can, of course, only be inferred.

Treatment.—The best treatment for this kind of uterine hemorrhage is the intra-uterine pack.[1] To tampon the uterus the anterior lip of the cervix is seized as high up as possible with two bullet-forceps; a strip of gauze is then caught by the end in a long pair of forceps and is introduced within the uterus. As soon as the point of the forceps enters the uterine cavity the left hand grasps the fundus, and only then is the forceps pushed in as far as it will go. The forceps is then loosened, withdrawn a little, a lower portion of the gauze strip is seized, and so the uterus is filled with gauze, lying in fan-shaped folds. The uterus is stimulated to contraction; so one gets the combined advantage of a tampon and a uterine stimulant.

The intra-uterine tampon for hemorrhage is of inestimable value. There is no other means so absolutely sure to check uterine bleeding.

Emotional Causes.—Sudden emotion of any kind arrests uterine contraction during labor and in the puerperal state. In the latter condition the usual result is a hemorrhage, which may be alarming. Barker[2] gives an interesting example: A healthy young primipara almost bled to death in the second twenty-four hours after labor in consequence of the brutal conduct of her husband, who was disgusted that his child was a girl. I have seen a sudden and profuse hemorrhage on the seventh day, the result of fright. The patient's step-son returned home late at night in a violent state of intoxication.

[1] Dührssen, "Die Uterus-Tamponade mit Iodoform-Gaze bei Atonie des Uterus nach normaler Geburt," "Centralblatt f. Gyn.," 1887, xi, 553.

[2] "The Puerperal Diseases," p. 15.

Relaxation of the uterus is a rare cause of hemorrhage after the first twenty-four hours. It is scarcely ever seen later than the third day, and when it occurs after the first day it is in women depressed in mind and body, exhausted by prolonged labor, weak from insufficient food or bad hygienic surroundings. It is treated on the same general principles as a primary postpartum hemorrhage from the same cause.

Retention of blood-clots is usually the result of uterine relaxation, uterine displacements, or a retention of portions of the ovum, around which the clot is formed. If these conditions are promptly treated, the retention of blood-clots is prevented. The effect of a large clot retained *in utero* is often a hemorrhage, possibly also septicemia. The mass of clotted blood should be removed as soon as the symptoms point to the presence of a foreign body within the uterus.

Fibroids.—If the puerperal state is complicated by intramural or submucous fibroids of the uterus, there are certainly a prolongation and an increase in amount of the bloody lochia, possibly a serious hemorrhage. The latter is peculiarly liable to happen if the tumor assumes the shape of an intra-uterine polypus. The diagnosis is only to be made by a careful physical exploration. The best treatment is the removal of the growth by torsion, by splitting its capsule and enucleation, by cutting the pedicle with scissors after ligation of the base, or with the wire écraseur. Hysterectomy may be indicated. In small intramural fibroid tumors in the puerperal state, ergotin, with styptol (gr. $\frac{1}{4}$), and strychnin, and the daily application of the faradic current, if practicable, do much to secure firm uterine contraction and prevent hemorrhage.

Hematomata along the genital tract may burst during the puerperal state, with serious external hemorrhage. The condition is described elsewhere.

Pelvic Engorgement.—Congestion of the pelvic blood-vessels may lead to puerperal hemorrhage. The congestion may be due to heart, kidney, or liver disease; to increased intra-abdominal pressure from any cause; to the determination of blood toward internal organs during a chill;[1] to premature sexual intercourse; to the erethism following the return of the husband to the wife's bed; to inflammation about the uterus; to subinvolution from any cause; to ovarian irritation, and to constipation. Mauriceau[2] describes a case of puerperal hemorrhage

[1] Winckel ("Path. u. Therap. des Wochenb.") reports 4 cases of this kind out of 114 of puerperal hemorrhage. I once observed a striking example during a malarial attack some days after labor.

[2] "Diseases of Women with Child and in Child-bed," translated by Hugh Chamberlen, London, 1752.

that continued quite profusely for five or six days, and which was only checked when "a pretty strong clyster" resulted in the evacuation of "a panful of gross excrements."

Wounds in the Genital Tract.—Secondary hemorrhage may occur from wounds in the cervix, vagina, and vulva. Occasionally, abnormally large blood-vessels are injured in these regions. On one occasion I saw a hemorrhage from an anomalous artery in the perineum that nearly proved fatal. It is possible that a vessel of considerable size might be wounded during labor, and yet, in consequence of pressure from the child's head or of an unstable plug of clotted blood, would not bleed until, at some time in the puerperal state, the tissues recovering their tone or the clot being dislodged hemorrhage would occur.

The diagnosis is easily made if the parts are exposed to view. The bleeding vessel may be detected and should be ligated.

Carcinoma of the Corpus Uteri and of the Cervix.—Carcinoma (syncytial) or sarcoma may develop at the placental site during the puerperium. Epithelioma of the cervix, if at all advanced, will surely cause some hemorrhage. The best treatment for the immediate control of hemorrhage from this cause is a uterine or a vaginal tampon. Hysterectomy should be performed, if possible, without delay. In inoperable cases with uncontrollable hemorrhage, ligation of the internal iliac, the ovarian, and the round ligament arteries is indicated.

Rare causes of puerperal hemorrhage are rupture of the uterine artery, reported by Hewitt,[1] with a fatal result six weeks after labor; the rupture of a distended vein in the cervix, followed by fatal bleeding, described by Hecker.[2] Meschek[3] reports a similar case, with like result, due to an eroding ulcer which opened a large vessel in the cervix. Johnston has reported a fatal puerperal hemorrhage due to rupture of a hematoma of the cervix.[4]

Puerperal Hematoma.—A form of hemorrhage in the female genitalia during or after labor, much more rare than the secondary hemorrhages just described, is an interstitial effusion of blood, with the consequent formation of a blood-tumor, varying in size with the degree of the hemorrhage. Levret seems to have been familiar with the accident, but with this exception a knowledge of the nature of hematoma in puerperæ has been acquired in quite recent times. The first systematic treatise on the subject is Deneux's monograph.[5] It was also fully described by Dewees.[6]

[1] "London Obstet. Trans.," vol. ix. [2] "Archiv f. Gyn.," Bd. vii, S. 2.

[3] "Zeitschr. d. Ges. d. Wien. Aerzte," 1854, x.

[4] Sinclair, "Pract. of Midwifery," 1858, p. 501.

[5] "Tumeurs sanguines de la Vulve et du Vagin," Paris, 1830.

[6] "Midwifery."

The accident is rare, but individual experience differs widely as to its frequency. Deneux was able to collect 62 cases, but had himself only seen 3 in a practice of fourteen years. Paul Dubois saw but 1 case in 14,000 labors. Velpeau,[1] writing five years after the appearance of Deneux's article, declared that it would be easy to collect the detailed accounts of 100 cases; that he himself had seen 25. Barker, of New York, reported 22 cases that came under his personal observation. Winckel quotes McClintock's claim that he had observed 25 cases, and places an exclamation mark after the quotation, evidently as a sign of incredulity.[2] The former has only met with 6 well-marked cases in an experience of almost 20,000 confinements. Bossi found hematomata twice among 5660 women in child-bed; Hugenberger, 11 times in 14,000 deliveries;[3] in Vienna it was noted 18 times out of 33,241 births.[4] This would indicate a frequency of 1 to 1600 births.

The **situation** is most frequently, by far, in one or the other labium majus, rarely in both. The blood-tumor may, however, occupy a position beneath the vaginal wall, on either side, posteriorly or anteriorly; in the ischio-rectal fossa; in the labia minora; in the carunculæ myrtiformes; under the skin of the perineum, between the superficial and median fascia; in the cervix; in the peri-uterine connective tissue; within the broad ligament; in the sub-peritoneal connective tissue, on the posterior and anterior abdominal walls, extending as high as the kidneys and navel (Cazeaux, Hugenberger, Winckel); under the skin of the mons veneris or over the inguinal ring (Velpeau). If the effusion occurs above the pelvic fascia, the blood forces its way upward toward the diaphragm; if below, downward toward the vulva.

Size and Form.—Small extravasations of blood are to be met with along the genital tract very frequently after labor; this form of thrombus is due to the fact that the mucous membrane is pushed in front of the presenting part with a glacier-like movement over the underlying tissues, and there thus occurs a laceration of the submucous connective tissue and the small blood-vessels contained in it. A careful examination often reveals numerous hematomata after labor, varying in size from that of a pigeon's egg to that of a walnut. It is the larger tumors that are rare. They may vary in size from that of a hen's egg to that of a child's head; in extreme cases, if the blood is diffused throughout a great part of the subperitoneal connective tissue,

[1] "Traité complet de l'Art des Accouchements," Brussels, 1835.

[2] "Lehrbuch der Geburtschülfe," 1889.

[3] "Hæmatoma Vulvæ im Verlauf der Schwangerschaft," "Archiv f. Gyn.," Bd. xxxiv, H. 1.

[4] These latter statistics are taken from Winckel's book, where a reference to the original authorities may be found.

PLATE 15.

Hematoma of the vulva (author's case).

the size of the effusion would be very large were the blood contained within a limited, circumscribed tumor.

In shape, blood-tumors of the genital tract may be globular; in the cervix they distend the tissues of one or both lips downward and outward, giving to the cervix the form of a shark's nose. In the vagina they may hang from the anterior or posterior wall in the form of a polypus (Fleischmann). In the labia the hematoma is sausage-shaped (see Plate 14).

Etiology.—The predisposing causes of puerperal hematomata are the engorged condition of the blood-vessels along the genital tract and the strain that is imposed upon them either by the pressure of the fetal body or by the great muscular effort put forth during labor. The more engorged the vessels are, the more likely is the occurrence of hematoma. Halliday Croom[1] attaches great importance to anteversion of the parturient uterus as a predisposing cause of vaginal hematoma, believing that thus an excessive strain is put upon the whole posterior vaginal wall, and a rupture of distended blood-vessels in this region is, therefore, more probable. Hypertrophic elongation of the cervix certainly predisposes to the formation of hematoma in that region during and after labor. The determining cause of the accident may be a direct injury to the tissues by forceps, a fall or a blow, or the violent straining efforts during the second stage of labor. In the majority of cases, however (86 per cent., Winckel), the occurrence of hematomata is apparently spontaneous. The immediate cause of hematoma is the rupture of a blood-vessel and the interstitial extravasation of blood; the vessel injured is commonly a vein, not rarely of large size. Possibly a number of smaller vessels may be ruptured. The injury to the blood-vessels is either a direct and immediate laceration, or else, later, a perforation by pressure necrosis.

Clinical History and Diagnosis.—The interstitial hemorrhage that results in a hematoma begins, with rare exceptions, during labor.[2] The extravasation of blood may at first be gradual, so that it does not attract attention until some time in the puerperal state. The distention of the vagina by the presenting part of the fetus may prevent all bleeding until the maternal tissues are relieved of pressure. If the bleeding results from necrosis of tissue, the result of prolonged pressure, the formation of a hematoma may first begin after delivery. In cases in which the accident has seemed to be the result of violent coughing or other exertion during the child-bed period, there had been, no doubt,

[1] "On the Etiology of Vaginal Hematoma Occurring During Labor," "Edinburgh Med. Jour.," vol. xxxi, pt. ii, p. 1001.

[2] Vinay reports a case in the sixth month of pregnancy after an epileptic fit, "Centralbl. f. Gyn.," No. 7, 1897.

some injury done the vessels during parturition. The subcutaneous or submucous laceration of tissue occurring, as a rule, during the second stage of labor is almost always associated with acute pain of a sharp, lancinating character, quite different from labor-pains. The suffering increases as the hematoma enlarges, and, in addition to the sharp pain of torn tissue, there are exaggerated and painful expulsive efforts excited by the presence of the tumor within or alongside the vagina. This is an almost constant symptom, but Barker reports a painless case. The hemorrhage into the tissues may be profuse enough to occasion the most marked signs of acute anemia. Pallor, failure of vision, a thready pulse, air-hunger, loss of consciousness, and, finally, death, may all be noted without the slighest external escape of blood. An examination of the patient shows a tumor occupying the situations already described, of varying size, and differing in consistency as the blood contained in it is fluid or clotted. If the hematoma is submucous, it presents a dark, purplish color, like clotted blood. If it is covered with skin, it presents a bluish, ecchymotic hue, although in the labium majus the color may be the same as in a submucous hematoma. As a rule, the swelling only appears after labor. It may, however, occur before the expulsion of the child, and it has repeatedly developed between the birth of twins.[1] If the tumor is formed during labor, it may present a formidable obstacle to delivery; if it appears in the puerperal state, it may dam back the lochia or give rise to dysuria or to retention of feces. With the history of a sharp attack of pain during labor, the subsequent rapid development of a tumor along the genital tract characteristic in its appearance and situation, the signs of internal hemorrhage, the diagnosis of the true condition ought not to be difficult; and yet a mistake is quite possible.

Puerperal hematoma has been confused with *varicose tumors of the labia*, *inguinal hernia*, and *inversion of the vagina*. Once in Barker's experience a vaginal hematoma was mistaken for a *fetal head*, and once for *placenta prævia*. Auvard[2] says that on first sight he took a hematoma of the anterior lip of the cervix for a *clot of blood* lying in the vagina. The Barneses,[3] in describing their case of cervical hematoma, write that they found a fleshy tumor projecting from the vulva which looked like a mass of *coagulated blood*, or which might have been mistaken for an *inverted uterus*. The diagnosis is more difficult in cervical hematomata than in those of the lower genital canal.

[1] One case reported by Dewees ("Diseases of Females," "Of Bloody Infiltration in the Labia Pudendi"), and six by Madame Sasanoff ("Annales de Gynécologie," December, 1884). Four of these latter cases died.

[2] "Trav. Obstet.," Paris, 1889, t. i, p. 449.

[3] "Sys. of Obst. Med. and Surg.," Philadelphia, 1885.

The former are rare. Besides the two just mentioned, others are described by Hohl, Braun, Earle (two cases), and Winckel.[1] Hematomata along the genital canal may burst soon after their formation, with appalling and possibly fatal hemorrhage. In cases of labial tumors the point of rupture is likely to be the boundary-line between the greater and lesser labia. A hematoma within the pelvis may open into the peritoneal cavity, with fatal hemorrhage.[2] In one case under my observation a large hematoma formed between the layers of the broad ligament. Four hours later the posterior layer of the broad ligament ruptured, the bleeding became intraperitoneal and unlimited, and the patient died before I reached her. After early rupture or primary incision of the tumor, profuse hemorrhage is likely, and secondary bleeding is apt to occur. This accident is rare when the tumor is opened after bleeding into it has ceased.

Winckel has thus summarized the terminations of puerperal hematoma: (1) Death by hemorrhage with or without previous rupture of the tumor; (2) death following suppuration of the sac and septicemia, most frequently after the sac has been opened; (3) rupture of the tumor, with recovery; (4) rupture of the tumor, with a resulting fistula; (5) perfect recovery by absorption of effused blood, without rupture of the sac. In fifty cases collected by Winckel from modern literature the tumor burst spontaneously in the first eight days in twenty-three. A hematoma may be evacuated not only by escape of the contained blood externally, but by diffusion of its contents under the skin. Dill[3] reports a case of large hematoma of the right labium, which ruptured internally and produced ecchymoses reaching to the nates and to the right knee, to the umbilicus, and even as high as the right axilla. Suppuration may occur in a blood-tumor that has not been ruptured at all, and the effused blood may be converted into a large accumulation of pus. As these abscesses are often in the neighborhood of the rectum, the pus may acquire a fecal odor, without a communication with the bowel. A rectovaginal fistula may result if the hematoma breaks its way into the rectum and also opens anteriorly into the vagina. Suppuration is most to be feared after the blood-tumor is opened and its cavity is exposed to the contamination of the atmosphere and of the lochial discharge.

Prognosis.—The formation of a hematoma during or after labor was formerly regarded as a more dangerous complication than it is considered to-day. Of Deneux's 62 cases, 22 died. Fatal cases have been reported by Cazeaux, Lubanski, Broers, Seulen,

[1] "Lehrbuch," 1889. [2] Williams, "Am. Jour. of Obstet.," Oct., 1904.
[3] "Dublin Jour. Med. Sci.," November, 1886.

Josenhans, Hugenberger, Braun, and the author. The causes of death in these cases were hemorrhage (in two instances into the peritoneal cavity), septicemia, and typhoid fever (?). Blot collected 19 cases since Deneux's paper was published, with 5 deaths. Perret, in an analysis of 43 cases, found 17 deaths. Of 11 cases observed by Hugenberger,[1] 4 died. Girard,[2] in an analysis of 120 cases, found 24 deaths. Johnston and Sinclair[3] report 7 cases during seven years' service in the Dublin Rotunda, with 2 deaths. Scanzoni met with 15 cases, 1 of which died. Winckel, among 50 cases, found only 6 deaths. Of the 6 cases in his personal experience, not one died. Barker reports 22 cases of his own, of which 2 died. Barnes[4] reports 2 cases with a favorable issue; Auvard,[5] 1 of cervical hematoma that disappeared by absorption. Croom's 3 cases all recovered. Death from a puerperal hematoma at present should be rare, especially if the patient's general condition is good and her hygienic surroundings are satisfactory.

Treatment.—If the hematoma is of moderate size, not larger than one's clenched fist, the main object of treatment is to secure absorption of the effused blood, and thus the disappearance of the tumor. It may, however, be necessary to remove an obstruction to labor if the tumor develops before delivery; to control the hemorrhage either before or after rupture of the sac; to treat the general symptoms of profuse bleeding; to evacuate the contents of the sac when suppuration has occurred, and to prevent septic infection.

To secure the disappearance of a hematoma by absorption cleanliness of the parts and rest are necessary. If the tumor is vaginal or cervical, frequent irrigation of the vagina is advisable. If the effusion is subcutaneous, cooling lotions and inunctions with carbolized oil often prevent inflammation and rupture of the sac. If the tumor appears before or during labor, and offers an obstacle to the delivery of the child, it must be freely opened; the contents, whether fluid or clotted blood, evacuated; pressure exerted by a tampon of iodoform gauze, in order to check the hemorrhage; while the extraction of the infant by forceps or after-version is hastened as much as possible. To control the hemorrhage into the tissues before external rupture has occurred, pressure, cold, and the internal administration of ergot may be tried. An ordinary tampon in the vagina is not admissible, for it would dam back the lochial secretion, and would become foul. Braun's colpeurynter, or a large

[1] "St. Petersburg med. Zeitung," 1865.

[2] "Contribution à l'étude des Thrombes de la Vulve et du Vagin dans leurs Rapports avec la Grossesse et l'Accouchement," "Thèse de Paris," 1874.

[3] Barker, *loc. cit.* [4] *Loc. cit.* [5] *Loc. cit.*

Barnes' bag, distended with ice-water, is the best appliance, for it can be easily removed at frequent intervals to allow an antiseptic irrigation of the vagina. If it is possible to avoid it, the tumor should not be opened while it is increasing in size, for there may be profuse hemorrhage at the time and a secondary bleeding later. This does not occur, as a rule, when the tumor is incised after the effusion ceases, and yet there are two cases on record in which hemorrhage occurred from tumors opened one and three weeks after their formation.[1] If the tumors are too large to be absorbed, or if there is threatened gangrene of their coverings, they should be opened.

Hematomata may burst within the first few days after their formation, and there may be, in consequence of the rupture, an alarming hemorrhage. In such cases it is best to enlarge the opening; to turn out the clots within the tumor; to search for the bleeding vessels, which may be seen spurting from the walls, and to apply a ligature. If this is impossible, and bleeding still continues, the cavity may be firmly packed with iodoform gauze, firm external pressure being exerted by a large pad and a T-bandage. The styptic salts of iron should not be applied, for such a firm, dense clot is thus formed that it takes a long time for it to disintegrate, the woman meanwhile running a risk of septicemia.

After the coverings of a hematoma are incised or ruptured, suppuration commonly occurs in the cavity; septicemia must be avoided in such cases by an iodoform tampon in the abscess cavity often renewed, and by frequently repeated irrigations. Suppuration may occur before the tumor has been opened at all. In such cases the pus must be evacuated. The opening should not be delayed too long, especially in suppurating hematomata of the posterior vaginal wall, or fistulæ may result. The general treatment for loss of blood is to be conducted in the ordinary manner when the indications call for it—hypodermatics of ether, brandy, and other stimulants; hot animal broths internally; "auto-infusion" by bandaging the limbs; and subcutaneous or intravenous injections of a normal salt solution.

Non-infectious Fevers.—Fever in the puerperal state not due to infection may arise from emotion, from exposure to cold, from constipation, from reflex irritation of any kind, from cerebral disease, from eclampsia, from insolation, from syphilis, from the exacerbation or persistence of an acute or chronic disease contracted during or before pregnancy.

Emotional Fever.—That fever may appear in consequence of emotions, clinical evidence leaves no doubt. The cause of the

[1] Parvin's "Obstetrics," p. 502.

fever being transient, perhaps momentary, the elevated temperature quickly sinks to normal. It is not in every person that powerful emotions are followed by an elevation of temperature to a noteworthy degree. There must, apparently, be predisposing causes in the nervous system of the individual. Emotional fever is most often met with in children, in hysterical girls,[1] and in women after child-birth. In child-bed there is a curious irritability of the organism, a lack of control over the mental processes.

Hunt's[2] records of seventy-five cases, confined to women free from infection and inflammation, in which the temperature was

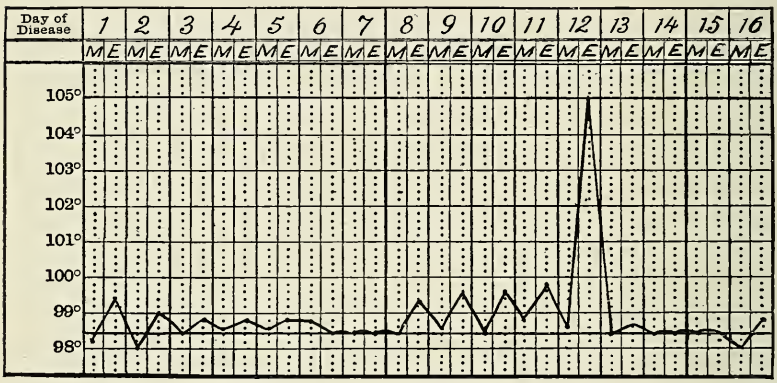


Fig. 517.—Chart of emotional fever from dread of an operation.

taken twice a day in the month, gives three apparently typical examples of fever from emotion. I have seen a number of examples of emotional fevers. Failure to receive an expected letter, fear of exposure in illegitimate pregnancy, the expected removal of the woman's infant to an asylum, dread of an operation, and a variety of mental disturbances have given rise in my experience to a high but transitory fever. Figure 517 shows the temperature record of a typical case. There had been an operation for mammary abscess in a hospital ward. It was witnessed by two puerperal patients. One of them, a young girl, shortly after experienced pain in the breast. She at once conceived a morbid dread of an operation in her own case. The beginning elevation of temperature in the chart indicates the commencement of engorgement and pain in the breast. These symptoms continued for a few days, when, after lying awake all night

[1] The case reported by Dr, Matomed is a famous example; the temperature is said to have reached 128° F. ("Lancet," 1881, vol. ii, p. 790).

[2] "Normal Course of Puerperal Temperature," "Practitioner," London, 1888, p. 81.

brooding on the subject, the girl's temperature began to rise in the morning, finally reaching the height indicated on the chart. The only antipyretic employed was the emphatic assurance of the

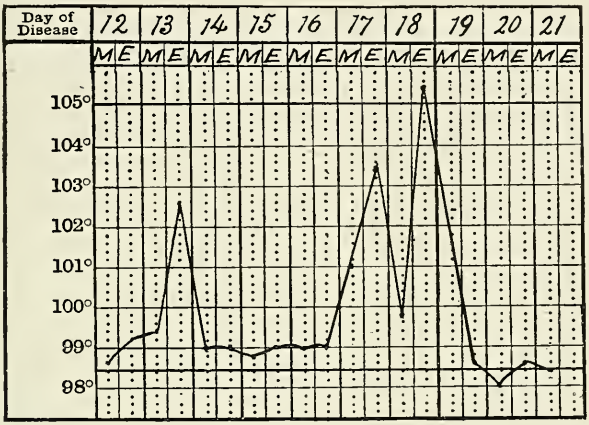


Fig. 518.—Chart of fever case from exposure to cold. The patient left her bed twice against orders, in her bare feet and night-gown. Each time there was a rise of temperature, quickly subsiding.

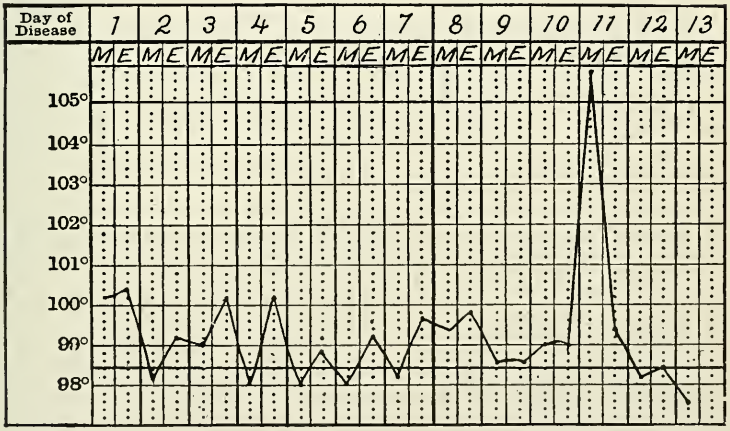


Fig. 519.—Chart of a woman constipated for six days in the latter part of the puerperal state. There had been one movement of the bowels, five days after labor, and then none for six days. A large dose of castor oil and an enema reduced the temperature to normal in a few hours.

resident physician that there was not, and would not be, the slightest excuse for an incision in the breast. The patient's fears being allayed, her temperature quickly sank to normal, where it remained.

Fever from Exposure to Cold.—In the sensitive condition of puerperæ it is not uncommon to see a febrile reaction follow undue exposure. A careless nurse or attendant may be responsible for too low a temperature in the lying-in room, or for ill-regulated ventilation, or for insufficient or ill-arranged bed-clothing. A

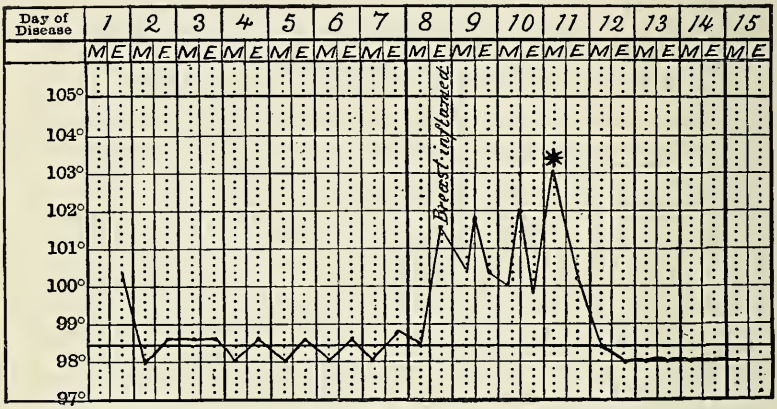


Fig. 520.—Reflex fever from mammary congestion. * Breast incised without finding pus.

wilful patient may leave her bed too soon and expose herself, thinly clad, to cold (Fig. 518).

Fever from Constipation.—The temperature-chart, figure 519, is that of a woman in the Philadelphia Hospital who had had but one evacuation of the bowels—on the fifth day—in the eleven days

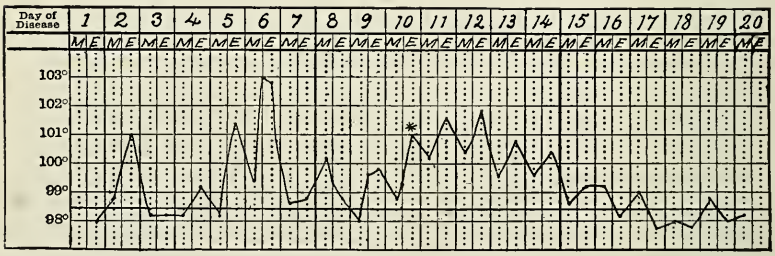


Fig. 521.—Fever followed by expulsion of tape-worm. * Tenia passed from bowel.

succeeding delivery. The temperature fell immediately after a large dose of castor oil and the administration of an enema, which produced an enormous fecal evacuation.

Fever from Reflex Irritation.—Physical irritation, as well as psychical, may be reflected in general elevation of the body-temperature during the puerperal state. The irritating point is

most often in the breast. There may frequently be found, in women of sensitive nervous organism, a well-marked fever, which can be traced to no other cause than engorgement and distention of the mammary gland. There is usually a history of exposure to colds or drafts of air in nursing the child. For twenty-four hours afterward there may be high fever and every evidence of acute illness. Hot fomentations on the breast, evacuation, support of the gland, and a saline purge dissipate the symptoms in twenty-four hours. The appended temperature-chart (Fig. 520) illustrates the influence of mammary congestion upon the temperature.

The focus of irritation may be anywhere in the body. A primipara was delivered under my care without difficulty of a healthy infant. During the early part of the puerperal state she complained of a constant and distressing headache; diarrhea appeared, which resisted treatment, and the woman's mental state tended rapidly toward pronounced melancholia. There was fever, apparently of a septic character. On the ninth day a tape-worm fourteen and one-half feet long was

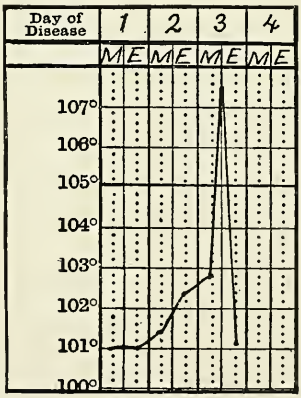


Fig. 522.—Rise of temperature following perforation of the uterus.

passed from the bowel, and shortly afterward the temperature became normal.

The great elevation of temperature which often follows perforation of the uterus into the peritoneal cavity, appearing, as it commonly does, immediately, should also be attributed more to an intense reflex irritation than to septicemia. The chart, figure 522, is from a case in which the placenta was abnormally adherent. Separation was accomplished four hours after delivery by means of the fingers and a curet. Ulceration of a limited area in the placental site followed, which ended in perforation and death on the third day. High fever occasionally appears in

consequence of an acute retrodisplacement of the puerperal uterus, sometimes as late as the fourth week. If the rise of temperature is simply due to irritation, it subsides within a few hours after the uterus is replaced.

Fever in the Puerperal State from Cerebral Disease.—A puerpera might have a tumor in the brain or spinal cord, insular sclerosis, locomotor ataxia, or degenerative changes in the brain—all of which could give rise to elevations of temperature.[1] It is, however, to cerebral hemorrhages and embolism that one should usually look for an explanation of fever arising from brain disease, for these accidents are by no means rare in the puerperal state; and if the hemorrhage or embolism affects certain regions, a rise of temperature, often to a great height, is almost sure to

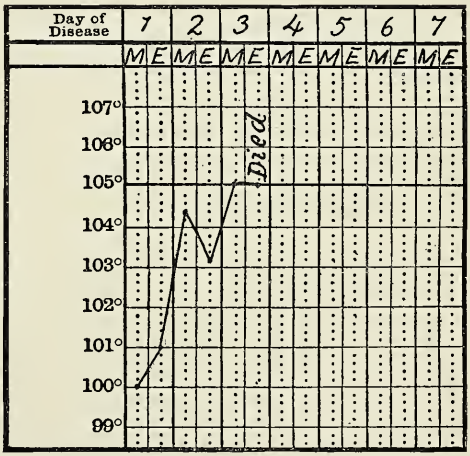


Fig. 523.—Fever-chart of patient who died of eclampsia.

follow. A temperature of 108° in the axilla has been noted in a case of cerebral embolism following child-birth.[2]

Fever with Eclampsia.—It is justifiable to put the fever of eclampsia among the non-infectious fevers of the puerperal state. Winckel,[3] writing in 1878, said he had observed and had called attention to the fever accompanying eclampsia fifteen years before; he was accordingly the first to refer to it. Bourneville and Budin published this fact as an original discovery in 1872.

[1] W. Hale White, "The Theory of a Heat-center, from a Clinical Point of View," "Guy's Hospital Reports," 1884, p. 49.

[2] Neve, "A Case of Cerebral Embolism with Hyperpyrexia following Childbirth," "Lancet," 1884, ii, p. 103.

[3] "Path. u. Therap. des Wochenbettes," 3. Aufl., 1878, S. 493.

With each convulsion there is a notable rise of temperature, until, finally, the fever may run very high.

Insolation.—Sun-stroke, or heat-stroke, is by no means an impossible accident to lying-in women in the torrid temperature of the American summer. The only case, however, that I know of occurred at sea in a ship sailing from France to New Orleans.[1] The cabin in which the woman was confined was hot and ill-ventilated. The temperature of the air was 93.4° F. A portion of the membranes was left behind, and the discharge was offensive, but there was no fever. On the fourth day, however, the temperature rose to 104°, and shortly

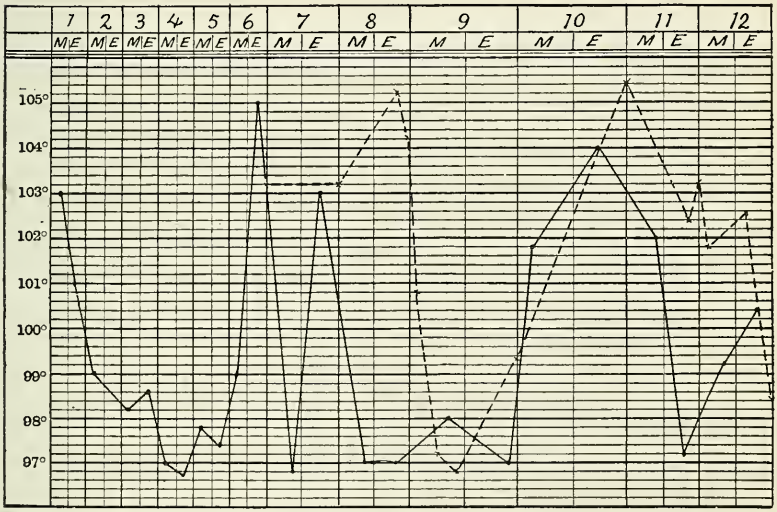


Fig. 524.—Temperature-chart of syphilitic fever.

after mounted to 109.4° in the rectum. The woman ultimately recovered.

Syphilitic Fever.—In my experience with syphilitic women in child-bed, the disease has complicated puerperal convalescence by the retention within the uterus of the hypertrophied deciduous membrane,[2] which is so often seen as a result of syphilis, by adherent placenta, by the development of pelvic exudates, and by septic infection. It is claimed, however, that there is a specific syphilitic fever without wound infection.

[1] Skinner, "Sur un Cas d'Hyperthermie post-puerpérale," "Le Progrès médicale," 1887, p. 269.

[2] See Kaltenbach on "Syphilitic Endometritis in Pregnancy and the Puerperal State," "Zeitschr. f. Geburtsh.," Bd. ii, S. 225.

Persistence or Exacerbation of Febrile Affections in the Puerperal State.—A woman may acquire any of the acute or chronic fevers during pregnancy, which may persist in the puerperal state or take on new activity during that period. This is true of all the infectious diseases, but particularly so of phthisis. The effect of labor upon the course of phthisis has interested many observers. It has been asserted that the disease makes no progress, or, at least, is very much retarded in the puerperal state. There is a fictitious appearance of regained health in the woman by reason of the accumulation of fat to which pregnancy disposes. The laity, therefore, enter-

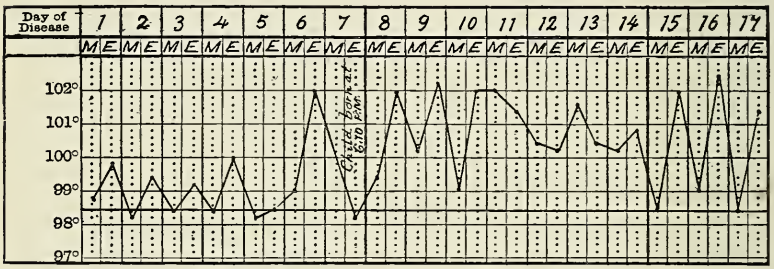


Fig. 525.—Fever-chart of woman with advanced phthisis in pregnancy and the puerperal state.

tain the idea that it is an advantage for the phthisical woman to become pregnant. No mistake could be more unfortunate. The drain and strain of the child-bearing processes are often accountable for the origin of phthisis in a woman disposed to tuberculosis, and, if the disease already exists, there is after delivery an exacerbation of the fever, an aggravation of the pulmonary symptoms, and a rapid loss of strength and vitality, which shortens the patient's life by many months. It is the duty of a physician to advise the tuberculous subject against marriage or maternity.

Acute Intercurrent Affections in the Puerperal State.—Any one of the acute diseases may fasten itself upon a woman after confinement. They acquire a special interest in this condition, for their course is often modified, the prognosis is commonly graver, and the diagnosis is more difficult. It is often difficult and occasionally impossible to distinguish certain diseases—as erysipelas, diphtheria, malaria, scarlet fever, and typhoid fever, occurring during the lying-in period—from septic infection.

Pneumonia.—Pregnancy and the puerperal state are grave complications of the disease. They increase the gravity of the symp-

toms and make the prognosis unfavorable. Pneumonia more frequently attacks a woman during the nine months of pregnancy than during the six weeks of the puerperal state, but the pneumonia of pregnancy often becomes a complication of the puerperium, for it frequently induces a premature expulsion of the ovum at the height of the attack, and convalescence or death occurs in the lying-in period. In 43 cases of pneumonia in pregnancy collected by Ricau,[1] there was premature expulsion of the fetus in 21. From these statistics it further appears that the likelihood of the accident is increased after the sixth month. In 28 of the 43 observations the women had not passed the sixth month of pregnancy; of this number 11 aborted. Of the other 15 cases, in which the pregnancy was past six months, there was premature labor in 10 instances.

The *prognosis* of pneumonia in pregnant women is grave. Of Ricau's 43 cases, 12 died: 5 before the sixth month; 7 after it. The infants were expelled in 21 cases prematurely; and of those which had reached sufficient development to exist outside the uterus the majority died. Tarnier [2] sums up the outlook for mother and child in the following way: The more advanced the pregnancy,the greater the probability of an expulsion of the fetus, the graver the prognosis for mother and child.

Treatment.—A discussion of the medical treatment of pneumonia has no place here. A consideration of the obstetrical treatment of the disease when it attacks the pregnant woman is important and is best handled by the obstetrician. The question to be decided by him is whether he will induce labor or avoid interference. Pregnancy complicates pneumonia by mechanically increasing the difficulty of respiration, by calling upon the heart for extra work, and by demanding unusual facilities for disposing of the waste-products of two organisms, part of which should be discharged through the lungs. It would seem, therefore, that the uterine cavity should be emptied for the mother's sake, more especially as the infant deserves but small consideration, being almost certainly doomed. But the evacuation of the uterus, the contraction of its walls, and great diminution of its blood-supply favor a determination of blood to other internal organs, among them the lungs. The exhausting discharges of the puerperal state, moreover, may fatally waste the patient's strength, while in her feeble and unresisting condition it is possible at least to have a general septic infection added to the pulmonary disease. Statistics certainly do not speak in favor of artificially inducing abortion or

[1] "Thèse de Paris," 1874.

[2] Tarnier et Budin, "Traité de l'Art des Accouchements," t. ii, Paris, 1886.

premature labor. Matton[1] says that of 18 cases in which pregnancy was interrupted 9 woman died, while in 20 women who suffered from pneumonia without abortion but 1 succumbed. Chatelain's[2] statistics include 39 cases; in 10, abortion occurred; in 9, premature labor was induced. Of the 19, 10 died, and of the remaining 20, 10 also died, showing that little was gained by the interruption of pregnancy.

Pleurisy may possibly complicate the puerperal state. It is simply an intercurrent affection, to be treated on general principles. It does not influence the course of pregnancy, nor is it influenced by the woman's condition.

The Exanthemata.—Scarlet Fever.—Although this disease in the puerperal state has attracted much attention and aroused extended discussion among medical writers, there are still several points in its relationship with the puerperium in dispute. It is not strange that there should be some confusion and difference of opinion in regard to scarlet fever in the puerpera, for its course is often much modified by the woman's condition; it may be complicated by the coexistence of septic infection; there may be, on the other hand, scarlatiniform rashes in the course of septicemia, although scarlatina is excluded; and, moreover, there may be, in certain cases, after infection with scarlatina, pelvic symptoms indistinguishable from those of an infected birth-canal.

Frequency.—Scarlet fever is a rare complication of the puerperal state. Prior to 1876 Olshausen[3] collected 134 cases; Winckel[4] saw one in Rostock; single cases are likewise reported by Palmer,[5] Parvin,[6] Busby,[7] Harvey,[8] Cummins,[9] and the author. Braxton-Hicks[10] asserts that he has met with 37 cases (!), chiefly in consulting practice. Epidemics of scarlet fever among puerperæ are described by Boxall[11] and Meyer,[12] in which, respectively, 16 and 18 women were attacked by the disease. In the discussion on Boxall's paper, several members of the London Obstetrical Society related individual experiences with the disease. It cannot be asserted that puerperæ are peculiarly dis-

[1] Jour. de Méd. de Bruxelles," 1872, p. 412.

[2] *Ibid.*, 1870, t. l, pp. 430, 516, and t. li, p. 11.

[3] "Archiv f. Gyn.," Bd. ix, S. 169.

[4] "Path. u. Therap. des Wochenbettes," 1878, p. 529.

[5] "Cincinnati Lancet-Clinic," 1887, ix, 481.

[6] "Amer. Jour. Med. Sci.," 1884, 179.

[7] *Ibid.*, 1887, p. 394.

[8] "Scarlet Fever and the Puerperal State," "N. Y. Med. Record," 1886, xxx, 376.

[9] British Med. Jour.," 1884, i, 760.

[10] "London Obst. Trans.," vol. xii, pp. 44–113.

[11] Abstract from "London Obst. Trans." in "Amer. Jour. of Obstetrics," 1888, pp. 547, 553, 666.

[12] "Ueber Scharlach bei Wöchnerinnen," "Zeit. f. Geburtsh.," Bd. xiv, S. 289.

posed to scarlet fever. Epidemics occur, it is true, in lying-in hospitals at long intervals, but the proportion of patients attacked is never very large. During the epidemic in the Maternity Hospital of Copenhagen, described by Meyer, only about one per cent. of the lying-in patients acquired the disease. Boxall says that 40 women were exposed to the contagion of scarlet fever during an epidemic, without the slightest detriment to their health. During the years 1871–'85 there were only 2 cases of scarlet fever, in the lying-in period, among the patients in the Copenhagen Maternity; in six years but 3 cases of the kind were seen in the hospital for infectious diseases (Meyer). In twenty years' hospital service in the Philadelphia, Maternity, and University Hospitals, I have seen but 2 cases of true scarlet fever in the puerperium.

Infection and Incubation.—Women after child-birth may be infected with scarlet fever in the ordinary manner—through the throat—or through wounds in the genitalia. The latter statement has been disputed, but the short period of incubation, the fact that the rash often begins at the vulva and spreads thence over the trunk, the common occurrence of pelvic inflammations, and the fact that the diphtheric patches usually seen in the throat of scarlet fever patients are met with commonly in the vagina when the disease attacks a lying-in woman, while the throat is affected to a minor degree or entirely spared—all indicate the genitalia as the point of entrance for the specific infection. It is likely that the majority of women affected during the puerperium are infected by actual contact with the disease germs on fingers or instruments inserted into the vagina; but it is quite possible that the poison of the disease may be drawn into the throat from the atmosphere or may be conveyed to the genitalia by the same medium. Before the adoption of antiseptic measures in surgical practice it was well understood that the poison of scarlet fever might find entrance to the body through a solution of continuity in the skin and mucous membranes. Paget long ago pointed out that the wounded are more susceptible to scarlatina.[1] The woman after child-birth is always a wounded person, and she is, therefore, more susceptible to attacks of the disease. This puerperal susceptibility explains the cases which, exposed to the contagion during pregnancy, only manifest the symptoms of the disease after labor, the poison lying dormant for varying lengths of time until its invasion of the body is facilitated by the wounds and abrasions which always attend parturition (Olshausen). This mode of entrance would also explain the short period of incubation when scarlet fever attacks a puerpera. Ordinarily, five to seven days intervene between

[1] See also Hoffa, Volkmann's "Samml. klin. Vorträge," No. 292.

the date of infection and the appearance of the first general symptoms. In the puerperal state, however, the time of incubation is shortened to twenty-four or forty-eight hours (Senn, Hervieux, Olshausen). In one of my cases the patient, two weeks before her confinement, had handled some old linen that had been used in a fatal case of scarlatina ten years before. She developed a violent and typical attack of scarlet fever forty-eight hours after her delivery.

Olshausen[1] says that four-fifths of all puerperæ attacked will manifest the first symptoms at some time in the first three days after labor; and this assertion has been supported by the majority of the cases reported since the appearance of his article.

Symptoms and Diagnosis.—A frank case of scarlet fever in the puerperal state is as easily recognizable as it is under any other circumstances in the adult male or female. But "in rare instances the disease may assume a masked form in which the ordinary signs of scarlatina are absent, or so slight and evanescent as to escape observation," and "in some such cases the only manifestation of the illness may be found in signs usually referred to septic poisoning" (Boxall).[2] It is, moreover, a well-recognized fact that one of the manifestations or accompaniments of septicemia in occasional cases is the appearance of a scarlatiniform rash. And, again, there are reported, from time to time, erythematous eruptions in the puerperal state resembling, on the one hand, the rash of scarlet fever, and, on the other, the eruption sometimes associated with general sepsis,[3] and yet apparently unconnected with either of these diseases. Finally, there may coexist in the same individual local inflammations about the pelvic organs of septic origin and a general infection of the whole organism with the poison of scarlet fever, as the puerpera with scarlet fever is more prone to streptococcic infection than any other patient.[4] It is obvious, therefore, that a definite diagnosis of scarlet fever in the puerperal state may be difficult or even impossible. The diffuse nature of the rash, followed by desquamation; the characteristic appearance of the tongue; the affection of the throat; the more exaggerated diphtheroid inflammation of the vagina; the exposure to the contagion of the disease; the occurrence

[1] *Loc. cit.*

[2] Braxton-Hicks takes an extreme position in this connection. He says that among sixty-eight cases of puerperal diseases in his practice for which there was a demonstrable cause, thirty-seven were due to scarlet fever. This is an overestimate, and it has not met with general acceptance. Even Boxall's moderate statement has a long list of names arrayed in opposition to it, but, to the writer's mind, the weight of evidence is distinctly in favor of his view.

[3] This word is used, in default of a better, to designate infection by the commoner pyogenic micro-organisms.

[4] T. Meyer, "Med. Klinik," 1905, Bd. 1, No. 32, p. 800.

of scarlatinous nephritis; finally, the infection of those who come in contact with the patient and the subsequent outbreak in them of a typical case of the disease,[1] make the diagnosis certain. But there are cases in which the existence of the disease, with symptoms closely resembling sepsis, is overlooked, or, if suspected, is only inferred.

The Peculiarities of Scarlet Fever in the Puerperal State.—Olshausen asserts that scarlet fever is modified in three ways when the disease appears during the puerperium; it almost always appears in the first three days after labor; the throat complications are slight; the eruption appears quickly, is rapidly diffused over the body, and is apt to assume a dark-red color. Winckel states that convalescence is commonly tedious. A careful study of the published cases must convince any one that scarlet fever exercises an unfavorable influence upon the puerperal state. The milk-secretion is often lessened, if not suppressed; there is often some change in the lochia, denoting probably an exanthematous endometritis or a diphtheric inflammation of the vagina. In a number of the cases reported, fetid lochia is noted; in some a "peculiar odor" is described; the only change noticed may be an increase or a return of the lochia rubra. In a considerable proportion of all the cases the discharges from the genitalia are unaffected. In 10 of the cases reported by Meyer rheumatic complications were observed. In 21 of the cases collected by Olshausen there was an evanescent tenderness over the uterus. The occurrence of pelvic inflammation is reported in so large a proportion of the entire number of cases that the association can not be a mere coincidence. Of Meyer's cases, for instance, 6 presented evidence of peri- and parametritis. It is possible that the specific poison of scarlet fever is capable of causing a pelvic peritonitis or an inflammation of the pelvic connective tissue when it enters the body through the wounds along the genital tract or finds entrance to the peritoneal cavity through the tubes. Or, perhaps, there may be a "mixed infection," as happens in gonorrhea. Whatever the explanation, it is highly probable that pelvic inflammation may occur as a consequence of scarlatinous infection during or after labor. Diarrhea may develop early in the attack. It is an unfavorable sign. Of 21 women in Olshausen's series thus affected, 15 died.

Prognosis.—If the attack is a frank one; if the genitalia are not much involved; if the pelvic tissues are not extensively inflamed, the woman will probably recover. It would scarcely be correct, however, to assert that the prognosis of scarlet fever in

[1] See the cases reported by Palmer and Harvey, *loc. cit.*

the puerperal state is favorable. The death-rate among Olshausen's cases was 48 per cent.; of those infected immediately after labor, 75 per cent. Of Meyer's 18 cases, 1 died. The 3 cases observed by Martin all died. Of Braxton-Hicks' 37 patients, 27 died. Many of these, however, were not cases of scarlet fever, but were probably cases of puerperal infection with a septic erythema. Galabin [1] twice saw fatal peritonitis during desquamation. On the other hand, Hervieux had 7 cases which ended favorably. All of Boxall's cases recovered. Legendre [2] reports 23 cases without a death. The single examples reported by Palmer, Parvin, Busey, Harvey, and Cummins all ended in recovery. The two patients under my observation recovered.

In scarlet fever, as in all the contagious diseases of the puerperium, the patient must be isolated and should not be allowed to nurse her child.

Erythematous Rashes in the Puerperal State.—A rash somewhat resembling the exanthem of scarlet fever sometimes makes its appearance on the skin of a puerpera, but a distinction can usually be made between the two. In the simple erythema there is apt to be a moderate and evanescent fever,[3] the pulse is rapid, and in most cases fetid lochia is noted,[4] with some uterine or pelvic tenderness; there is often intense itching and usually desquamation; miliaria often make their appearance, especially on the abdomen under the binder, and there may be desquamation. The eruption is very likely the expression of a septic infection, usually of a mild degree; but occasionally erythema may be associated with the gravest forms of septicemia. Mackness explains the eruption by the supposition that some septic products are evacuated through the sweat-glands, irritating the skin and producing a general hyperemia. His theory is supported by the fact that the rash is at first punctate, seeming to begin usually at the hair-bulbs, and soon after becoming diffuse. The belief in the septic nature of the eruption is shared by Winckel, Kaposi, Maygrier, Geneix, Farre, and many others. The superficial resemblance that this affection bears to scarlet fever has led many observers into error. Raymond [5] would have one believe that the eruption is the manifestation of an attenuated form of scarlet fever. With the same idea in mind Gueniot calls the rash scarlatinoid. It is likely that future

[1] Discussion on Boxall's paper, *loc. cit.* [2] See Parvin, *loc cit.*

[3] Mackness, "Some Scarlatinous Rashes Occurring During the Puerperium," "Edinb. Med. Jour.," August, 1888.

[4] Mackness, *loc. cit.;* MacDonald, "Edinb. Obst. Soc. Trans.," 1884–85, x, 235; Charpentier; Guéniot, "Thèse," 1862; Poupon, "Erythème scarlatiniform chez une Femme recemment accouchée," "La France médicale," 1884, i, 41.

[5] "Thèse d'Aggregation."

investigation will confirm an opinion, already expressed, that there is an "infectious erythema" dependent upon the invasion of the body by a specific microbe, which, it is claimed, has been isolated.[1]

Loviot[2] has reported an erythema recurring a number of times during a year after an attack of puerperal sepsis. Lipinsky[3] also reports two cases of recurrent erythema in the puerperium. Gaertig[4] reports an erythema recurring after three successive labors, twice with fever, the third time without.

Measles.—Pregnant women are rarely attacked by measles The disease is even more rare in the puerperal state, owing to the shorter duration of the period. The measles of pregnancy, however, usually becomes a complication of the puerperium by inducing an expulsion of the ovum. Nine out of eleven cases of measles during pregnancy reported by Klotz[5] caused a premature expulsion of the fetus. Occasionally, the disease first manifests itself in the puerperal state. Tarnier[6] describes an instance in his own experience. Measles in the child-bearing woman is a dangerous disease. There is a disposition to hemorrhage, and pneumonia is a frequent and a very dangerous complication.[7]

Small-pox.—Pregnancy and the puerperium increase the gravity of all the eruptive fevers. This is true of small-pox as of the rest. Luckily, the disease is a rare one under any circumstances in this country, and as a complication of the puerperal state it is of very exceptional occurrence.

A case of *rötheln*[8] during the puerperal state has been reported. I have also observed one case, mild in character, ending in recovery.

Erysipelas.—The practical identity of the streptococcus erysipelatis and the streptococcus pyogenes explains the fact that the germs of the disease, when introduced into wounds along the genital canal or into the uterus, are capable of generating a violent form of puerperal sepsis without manifesting externally the rash, which is supposed to be distinctive of erysipelas. A large number of cases might be cited in which contact with puerperal-fever patients originated an attack of erysipelas, or, on the other hand,

[1] Simon et Legrain, "Contribution à l'Étude de l'Érythème infectieux," "Ann. de Dermatol. et de Syphilog.," November, 1888.

[2] "Annales de Gyn.," July, 1894.

[3] "Centralbl. f. Gyn.," 1894.

[4] *Ibid.*, p. 720.

[5] "Archiv. f. Gyn.," Bd. xxix, S. 448.

[6] Tarnier et Budin, "Path. de la Grossesse," p. 17. A good bibliography precedes the chapter.

[7] Two fatal cases are reported by Hulburt, "St. Louis Courier of Medicine," 1887, xvii, p. 549.

[8] Kite, "Boston Med. and Surg. Jour.," August 18, 1887.

in which puerperæ exposed to the contagion of erysipelas developed virulent forms of puerperal sepsis.[1]

Pneumonia is a frequent complication of puerperal erysipelas. During an epidemic that Winckel observed in 1880, six out of thirteen puerperæ attacked manifested this complication.

In relation to erysipelas, as to all the infectious fevers of the puerperium, it is important for the obstetrician to realize that if these diseases fasten themselves upon the woman after child-birth in the ordinary manner,—that is, erysipelas through a scratch in the skin, scarlet fever from the throat or lungs, and so on,—their course, symptoms, and treatment differ little from the ordinary manifestations and management of the respective diseases in an adult female; but when the woman's genital canal is infected, the history is different. The symptoms are, to a great extent, the same, no matter what the nature of the infection. There may be the same endometritis, the same involvement of the uterine walls, the lymphatics, the blood-vessels, the connective tissue, the tubes and ovaries, and the serous membranes after infection of the pelvic organs by any one of the numerous pathogenic micro-organisms. Winckel has seen, in all, 42 cases of erysipelas during pregnancy and the puerperal state; 36 of them developed after the delivery of the infant; 6 occurred during pregnancy. Of the cases in pregnant women, not one had its origin in the genitalia. Of the 36 cases in the puerperal state, 28 began in the genitalia, 2 in the breast, and the remainder in the face and scalp. Winckel, from an extensive study of the subject, offers the following points of evidence as to the etiology of erysipelas in the puerperal state and its connection with puerperal sepsis:

1. By far the most frequent points of origin—in five-sevenths of all the cases—for puerperal erysipelas are the genitalia and nates. There are endemics in which not a single case of facial erysipelas appears.

2. Primiparæ contract the disease three to four times as frequently as multiparæ.

3. Puerperæ with wounds upon the genitalia are particularly predisposed to the disease.

4. Those who have undergone difficult operative deliveries acquire the disease much more frequently than others.

5. The infants of women with erysipelas remain free from the disease. (Gusserow, in fourteen cases, saw the child infected twice; Goodell, once.)

6. The larger the number of women diseased in a puerperal-fever epidemic, the larger is also the number of erysipelatous cases.

[1] Winckel, "Ueber das puerperale Erysipel," Separat Abdruck aus dem "Aerztlichen Intelligenz-Blatt," München, 1885.

Frequency.—Erysipelas in the puerperal state manifested by a cutaneous eruption is very uncommon.

Symptoms and Diagnosis.—If the erysipelas manifests its existence by a cutaneous eruption, the symptoms are distinctive and the diagnosis is plain. If, on the contrary, the streptococci invade internal organs and tissues, it is impossible to differentiate the case from one of ordinary streptococcus infection.

Prognosis.—If the case is one of frank erysipelas, starting from the breast or the face, the prognosis is relatively favorable. Among 14 cases of the kind described by Winckel there were only 2 deaths. Of the 28 cases in which the erysipelas originated about the vulva 12 ended fatally.[1]

Treatment.—The treatment of erysipelas of regions distant from the pelvic organs in the puerpera differs in no respect from the treatment of the disease under any circumstances, except that the greatest care must be exercised not to transfer the streptococcus infection to the genitalia, and not to allow the child to nurse from an infected breast.

Puerperal Diphtheria.—If infection occurs in the throat, the disease is an accidental complication of the puerperal state. If the infection has occurred in the genitalia, a variety of puerperal sepsis ensues that is considered in another place.

Puerperal Malaria.—Malaria is something more than an acute intercurrent affection of the puerperal state, for in some important particulars the condition of the woman's organism after labor modifies the disease. The liability to infection is increased after child-birth. Bonfils[2] has collected 140 observations of malarial fever in child-bearing women. His conclusions are as follows: Malarial fever after child-birth predisposes to puerperal hemorrhages, which occur apparently in consequence of the disturbances in blood-pressure accompanying the chills and fever. The lacteal secretion is suppressed during the exacerbation of fever, but appears again after the febrile stage; it is, however, less abundant. Whether or not the milk can convey the specific poison of malaria from the mother to the nursing infant is an undecided question. The most striking phenomenon in the puerperal state of women already infected with malaria is the reawakening of malarial manifestations, probably by reason of the traumatism and the physical depression follow-

[1] It goes without saying that the puerperal state predisposes to attacks of erysipelas by furnishing so many points of entrance for the poison in the wounds of various degrees along the genital canal. It would seem, also, that the condition of the whole organism favored the occurrence of the disease. Döderlein ("Münch. med. Wochens.," xxv, 1888) reports a case in which the poison lay latent for a year in a lymphatic gland and broke out into fresh activity after an abortion.

[2] "Paludisme et l'uerpéralité," "Ann. de Gynéc.," 1886, xxvi, 125.

ing child-birth. The third day after labor seems to be the usual time for the reappearance of the disease, probably because of the slight elevation of temperature and of the general excitement of the organism which accompanies the establishment of lactation.

In my experience the fever is at first usually continuous. As the patient is brought under the influence of quinin the fever becomes intermittent and finally disappears (Fig. 526). The puerperal state predisposes to grave forms of malarial intoxication.

The disease may pursue the mildest possible course, with very slight and irregular fever, which is easily controlled by quinin in small doses. On the other hand, the worst example of malarial infection which I have ever seen occurred in the last

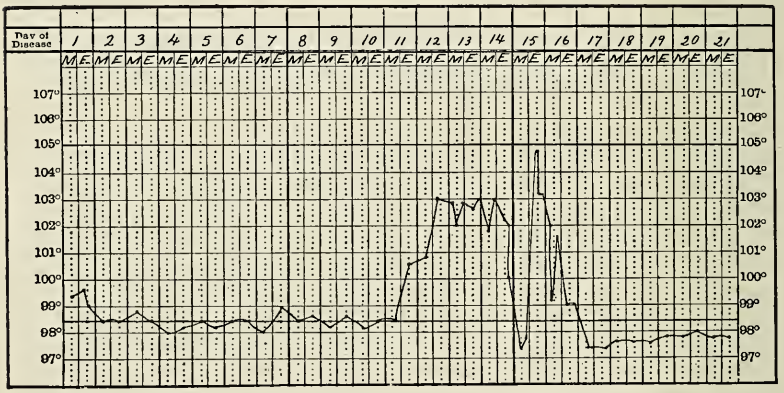


Fig. 526.—Malaria in the puerperium yielding to quinin when intra-uterine disinfection had failed.

month of pregnancy. During the previous eight months the patient had had two attacks of malarial fever. Within a week or two of term, the disease reappeared in a grave form. There were congestive chills, a temperature running above 104°, and finally coma. The fever was almost continuous. In the midst of the attack labor came on, and after some difficulty the child was extracted by the breech. After delivery the woman grew worse, and death seemed inevitable, but by the daily administration of seventy to eighty grains of quinin for several days, the fever was conquered and the patient made a rapid recovery.

Diagnosis.—The microscopic examination of the blood should clear up a doubtful case. The whole subject of malarial fever in the puerperal state has been discredited by the tendency to conceal cases of puerperal infection under this name. The prac-

titioner should always be upon his guard in this respect. While not so satisfactory to him, it is far safer to his patient to err in the opposite direction; to regard a doubtful case of fever during the puerperium as of septic and not of malarial origin, unless the proof in support of the latter belief is convincing.

Treatment.—In the majority of cases larger doses of quinin are required than under other circumstances. Reference has been made to a case in which, on the average, seventy-five grains were administered in the twenty-four hours for several successive days. In another case under my observation, forty-five grains a day were given for a long time, with success in controlling the fever and with no ill effect upon the patient. Several times an attempt was made to reduce the dose to thirty grains, but the reduction in the quantity of the drug was always followed by the reappearance of the fever. It was at one time erroneously taught that quinin administered to a nursing woman had a disastrous effect upon her milk. Even in very large doses it does not pass into the milk.

Rheumatism and Arthritis.—Arthritis in the puerperal state is either a manifestation of septic infection, with a localization of the septic inflammation in a joint, or else, as a rheumatic arthritis, is

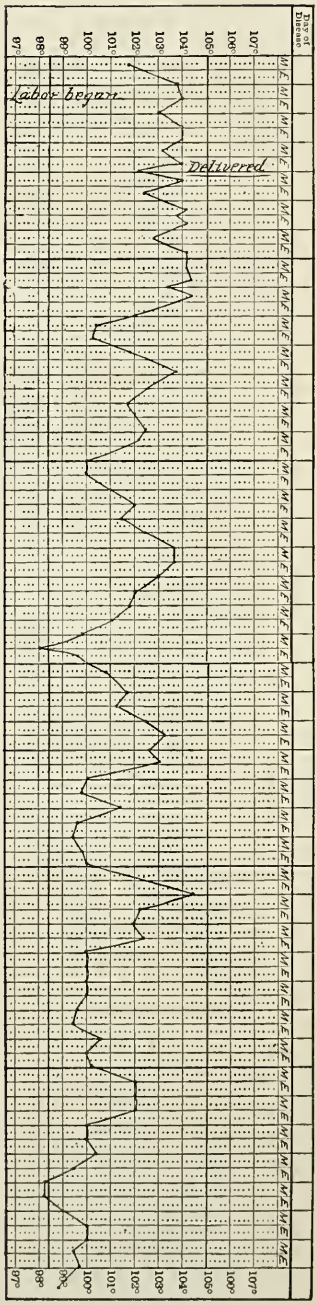


Fig. 527.—Malarial fever in pregnancy and the puerperal state.

simply an accidental intercurrent affection. The diagnosis between septic arthritis and simple acute rheumatism is not always easy. In the latter, during the puerperal state, the symptoms are the same as in any adult. Inflammation of the joints following septic infection, on the other hand, presents certain peculiar signs. The joint affected is usually a large one, very often the knee; the inflammation is not fugacious;[1] it is exceedingly stubborn

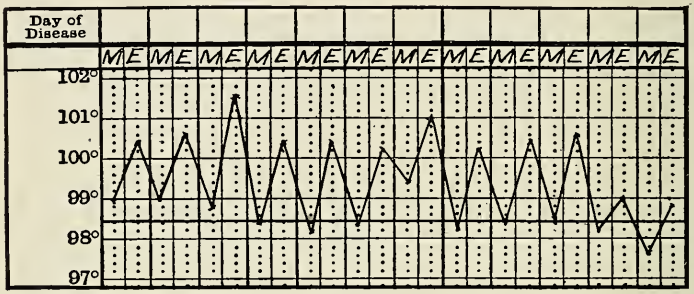


Fig. 528.—Temperature-chart of a puerpera with fever and uterine tenderness, with no other symptoms of sepsis. Irrigation and curettage of the uterus had no effect upon the fever, which yielded immediately to the salicylate of sodium. There had been an attack of muscular rheumatism during pregnancy.

in its resistance to all treatment; the duration is usually prolonged, and in many cases there follows a complete ankylosis of the joint. There may be very little evidence of general septic infection. The arthritis may make its appearance late in the puerperal state. It may be accompanied by very moderate fever of an irregular type. It is more apt to appear in women who have had gonorrhea. In the worst cases of general septic infection the joints may be the seat of metastatic abscesses as well as other portions of the body; but in these cases the symptoms pointing to a general septic infection are plain.

Prognosis.—The average duration of the septic arthritis is about three months. Recovery is the rule, but with an ankylosed joint (sixteen times out of twenty-three (Tison)). In scrofulous subjects the affected joint may become the seat of a tuberculous inflammation.

Treatment.—General medication is of little use. The salicylates are of no value. Local treatment, in the shape of counter-irritation (iodin, blisters, cauterization), may hasten the cure.[2] If the inflammation is acute, soothing lotions must be used. The

[1] There are, however, occasional exceptions to this rule.

[2] A ring of iodin painted around the joint and equal parts of mercurial and belladonna ointment as a plaster directly over it is a good routine treatment.

joint at first should be immobilized, but later a cautious employment of massage and passive motion may prevent ankylosis.

Muscular rheumatism may complicate the puerperal state. If the disease affects the uterine muscle and is associated with much fever, the only means, practically, of distinguishing between this affection and puerperal infection with septic inflammation of the uterus is the therapeutic test—the administration of a salicylate.

Gonorrhea.—The frequency of gonorrheal infection in the puerperal state depends upon the class of society to which the women belong. In the lower classes, seen in dispensary practice, it is very common. In the upper classes it is decidedly rare. The proportion of cases varies, too, in different localities. Noeggerath and Sänger[1] report that among 1930 gynecological cases during a single year, in private and polyclinic practice, 230 (twelve per cent.) owed their sufferings to gonorrheal infection. Among 398 pregnant women, 100 had a purulent discharge, presumably from gonorrhea (twenty-six per cent.); forty of the children developed blennorrhagia. This estimate is too high to be correct as an average.

The differential diagnosis between gonorrheal and other pyogenic puerperal infections is made, according to Sänger, by the following signs: The progress of gonorrhea is slower. It very rarely breaks out in the early part of the puerperal state, appearing first about six or seven weeks after delivery. The most violent cases observed by Sänger were acquired during the period of uterine involution. It is difficult to draw a sharp distinction in all cases between infection by gonococci and by the other pathogenic micro-organisms causing local inflammation in the genital tract. On the one hand, there are many infectious bacteria which cause a severe inflammation of the mucous membrane along the whole canal; and, on the other hand, gonococci can, without doubt, excite inflammation of the deeper tissues, and are certain, if they escape from the tubes, to light up a sharp attack of peritonitis. The diagnosis may be made with approximate certainty if the disease existed during pregnancy, or if a careful examination detects an inflammation of the urethra and of the vulvo-vaginal glands, or if it is possible to detect the gonococcus. The consequences of gonorrhea in the puerperal state may be most serious. There is often a mixed infection, gonococci preparing the way for streptococci or other pathogenic micro-organisms. The local inflammation, under any circumstances, may become acute, and may be accompanied by violent peritonitis.

[1] "Ueber die Beziehung der gonorrhöischen Infection zu Puerperalerkrankungen," "Wien. med. Blätter," 1886, S. 902.

There may be a rapid accumulation of pus in the tubes during the puerperium, but usually the pyosalpinx develops slowly.

Skin Diseases.—The diseases of the skin which make their appearance during the puerperal state, and are apparently dependent upon that condition for their origin, are often a manifestation of septic infection. This is certainly true of erythema. It would appear to be true also of cases of pemphigus, which rarely occur after delivery. This disease [1] usually breaks out on the third or fourth day of the puerperal state. It may or may not be associated with some rise of temperature. In one case the contents of the blebs had a distinctly fetid odor. The duration of the disease is protracted. It lasts, on the average, ten weeks. The woman's general condition may require stimulants. The distressing itching or burning of the skin which sometimes accompanies the disease is relieved by a weak carbolic acid solution.

Diastasis of the Abdominal Muscles in the Puerperal State.—If the uterus has been much distended during pregnancy, and if the abdominal muscles during labor have been called upon to exert an unusual amount of force, there may occur a wide separation of the recti muscles, leaving space between them for a hernia of the abdominal contents. Prochownick [2] has reported two interesting cases of the kind. There was suddenly developed during the puerperium sharp abdominal pain with nausea and vomiting. Careful examination excluded puerperal infection, and detected the protrusion of coils of intestine between the recti muscles. The hernia was easily reduced, and a recurrence was prevented by a compress and adhesive strips. In both instances the symptoms yielded at once to this treatment. The accident is not likely to be a common one among English-speaking people and in countries where the use of the abdominal binder after labor is a universal custom. Permanent diastasis of the muscles with pendulous belly and splanchnoptosis is treated by an abdominal binder, massage, electricity, and Swedish exercises. If such treatment fails, Webster's operation (p. 621) is indicated.

Flatulent Distention of the Abdomen (Tympanites).—There occurs occasionally in the puerperal state an extreme distention of the abdomen, due to the overdistention of the intestines with gas. The cause of the flatulence is a partial or complete paralysis of the muscular coat of the intestines without peritoneal inflammation. A firm binder, turpentine by

[1] Croft, "A Case of Pemphigus Recurring after Four Consecutive Labors," "Lancet," London, 1887, ii, 858; Wood, "A Case of Postpartum Pemphigus," *ibid.*, 1888, ii, 468.

[2] "Die Diastase der Bauchmuskeln im Wochenbett," "Archiv f. Gyn.," xxvii, 419.

the mouth, and asafetida by the bowel suffice in cases of moderate degree. In graver cases a grain of calomel every half hour until six grains are taken; two hours after the last dose of calomel a quarter of a grain of elaterium, and two hours later an enema of an ounce of glycerin, a half ounce of turpentine, a half ounce of Epsom salts, and two ounces of water with strychnin and salicylate of eserin hypodermically are indicated. In the worst cases the only remedy which affords relief is a puncture of the large intestine with a fine trocar. This procedure appears to be devoid of danger. It has long been applied in the treatment of animals, especially sheep, to relieve flatulent dyspepsia. It has also been adopted with good results in human beings.[1] In one recorded instance the bowel was tapped twenty-eight times without bad result. Instead of puncturing the bowel, the abdomen may be opened and the intestines punctured with a knife and irrigated.

I have had under my care a case of giant colon in which pregnancy and labor gravely aggravated the condition. The abdominal distention became so extreme that it was necessary to make an artificial anus by inguinal colotomy on the left side to save the woman's life. Twenty-eight pounds of feces were washed out of the colon. The patient recovered.

Acute congestion and edema of hemorrhoids in the puerperium causes great distress. Immediate relief is afforded by forcible dilatation of the sphincter under anesthesia.

Diseases of the Urinary System.—The Urine.—The average amount of urine passed in the first six days is 11,160 grams. The average specific gravity is 1010. The quantity passed upon each day averages as follows: The first day, 2025 c.c. (74.4 fl. oz.); the second day, 2271 c.c. (76.5 fl. oz.); the third day, 1735 c.c. (58.6 fl. oz.); the fourth day, 1772 c.c. (59.8 fl. oz.); the fifth day, 1832 c.c. (61.9 fl. oz.); and the sixth day, 1949 c.c. (65.8 fl. oz.). It is not at all rare to find albumin in the urine[2] shortly after delivery, but as it is only a temporary phenomenon, disappearing within forty-eight hours, as a rule (Blot, Ingersley, Lantos), and seems to exercise no injurious influence upon the woman's condition, it may be regarded as practically a physiological occurrence.

The appearance of sugar in the urine after delivery is also a very common occurrence, which has been attributed to the absorption of lactose from the mammary gland; indeed, one ob-

[1] Priestley, "Note on Puncture of the Abdomen for Extreme Flatulent Distention," "Lancet," London, 1887, i, 718.

[2] Examining the urine of 600 puerpera directly after delivery, Lantos found albuminuria in 59.33 per cent. This is a more common occurrence by one-third in primiparæ than in multiparæ ("Beiträge zur Lehre von der Eklampsie und Albuminurie," "Archiv. f. Gyn.," Bd. xxxii, p. 365).

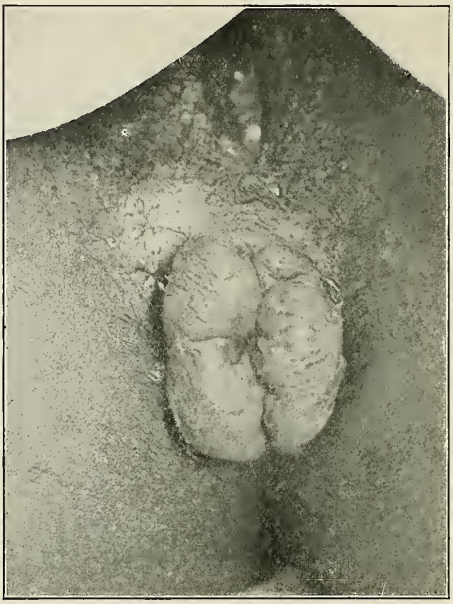


Fig. 529.—Edematous hemorrhoids in the puerperium.

Fig. 530.—Transverse colon in case of giant colon.

server declares that the quantity and quality of the milk may be judged by the amount of sugar in the urine.[1] But, as a matter of fact, glycosuria is more common when the milk-secretion fails than when the supply is most abundant.[2] The phosphates and the sulphates increase with the urea and with the excretion of milk.[3] The appearance of peptones in the urine of recently delivered women is quite constant.[4]

The lochia may also contain peptones, but independently of the peptonuria and without influencing the quantity of peptones in the urine.[5] If the urine after labor contains albumin in considerable quantities and persistently, it is evidence of trouble in the kidneys. There are usually associated with persistent albuminuria other symptoms indicating kidney disease. One of these is acute pain, most often in the head, but sometimes referred to the epigastrium or to other regions of the body. There may be edema. There is found in the urine microscopical evidence of degenerative changes in the renal epithelium. Albuminuric retinitis is not a very uncommon accompaniment of kidney disease in the puerperium, and may induce complete blindness, but it should be remembered that there may rarely occur a temporary blindness in the puerperal state independent altogether of kidney disease.[6] It usually comes on shortly after delivery, and lasts for a few days. Typical examples have been reported by Brush and by Königstein. The latter attributes the accident to a spasmodic contraction of the retinal vessels traceable to a vasomotor disturbance. The loss of vision may follow severe hemorrhage or eclampsia, may be associated with albuminuria, or may be the result of a septic panophthalmitis. Königstein suggests, as a treatment for the temporary blindness due to a spasmodic action of the retinal vessels, the inhalation of amyl nitrite. The woman's nervous system exercises a powerful influence on the composition of the urine. Cameron[7] has

[1] Blot, "Comptes Rendus," xliii, p. 676.

[2] Hofmeister, "Zeitschr. f. phys. Chemie," Bd. i, S. 703; Johannovsky, "Archiv f. Gyn.," Bd. xii, S. 448. A full bibliography on this subject may be found in Schroeder's "Geburtshülfe," 10. Aufl., p. 236.

[3] Grammatikati, "Ueber die Schwankungen der Stickstoffbestandtheile des Harns in den ersten Tagen des Wochenbettes," "Centralblatt f. Gyn.," 1884, p. 353.

[4] Fischel, "Ueber puerperale Peptonurie," "Archiv f. Gyn.," 1884, xxiv, p. 400, and "Neue Untersuchungen über den Peptongehalt der Lochien nebst Bemerkungen über die Ursachen der puerperalen Peptonurie," *ibid.*, 1885, xxvi, 120; Biagio, "La Peptonuria puerperale," "Ann. di Ostet.," 1887, ix, 202.

[5] Fischel, *loc. cit.*

[6] Brush, "A Case of Temporary Blindness following Child-birth," "Obstet. Gazette," vii, 1884; Königstein, "Erblindung nach einer Geburt in Folge von Ischæmia Retinæ," "Wiener med. Presse," 1885, xxvi, 585.

[7] "High Temperature and Glycosuria in the Puerperal State, the Result of Nervous Influences," "Montreal Med. Jour.," Jan., 1889.

reported an extraordinary case of high temperature and glycosuria in the puerperal state, the result of nervous influences. The temperature rose during waking hours and fell during sleep, without corresponding variation in pulse. The glycosuria seemed to have direct connection with the nervous phenomena, and lasted only a short time.

Hematuria, when seen in the puerperal state, has almost invariably persisted from pregnancy. In these cases there are usually bleeding hemorrhoids of the bladder, due to the mechanical interference with the pelvic circulation by the presence of the gravid womb. The blood disappears from the urine in a few days after delivery. In bad cases of septic infection of the vesical mucous membrane, as a result of injury with instruments, or as a consequence of vesicovaginal fistulæ, the same symptom may appear, but the differential diagnosis is easy. Renal and vesical calculi, malignant tumors of the kidney and bladder and papillomata of the latter are possible causes.

The Kidneys.—Hervieux divides the diseases of the kidneys in the puerperal state under four heads: First, inflammatory nephritis; second, metastatic nephritis; third, evanescent albuminuric nephritis; and fourth, subacute albuminuric nephritis. In the first stage of inflammatory nephritis one finds hyperemia and tumefaction of the organ. Often this condition is associated with general septicemia. If the disease develops primarily in the puerperal state, it is probably a manifestation or an accompaniment of general septic infection, and is often undetected in the midst of other complications presenting more obvious and more alarming symptoms. An intense hyperemia of the kidney associated with septic infection may result in an apoplexy. Metastatic nephritis is, of course, the result of septic infection. In the evanescent albuminuric nephritis the kidney is increased in size. Its surface is smooth; the fibrous tunic, thickened and injected, is easily stripped off. This increase in size is due principally to the tumefaction of the cortex. In the fourth variety of kidney diseases in the puerperal state the course is more tedious, and it may pass into chronic nephritis. Maguire asserts that the lesion most commonly found in cases of puerperal albuminuria is one of anemia of the kidney with fatty degeneration. Lantos,[1] in the records of 39 postmortem examinations of puerperæ who had not died from eclampsia or nephritis, found in 15 cases the kidney described as "anemic," in 21 "pale," and only in 3 "congested." Among 16 women who had presented symptoms of kidney disease there were found

[1] *Loc. cit.*

twice acute parenchymatous nephritis, once acute hemorrhagic nephritis, nine times parenchymatous degeneration, and four times albuminoid degeneration.

In rare instances, complete suppression of urine after labor is observed, usually with a fatal result. It is explained by an acute exacerbation of an old nephritis.[1]

Dislocation of the kidney may occur in the puerperium or during labor. It may be twisted on its pedicle and an acute hydronephrosis may result. The kidney is very much enlarged, there is intense pain and perhaps high fever. Rest in bed and the application of the ice coil give relief. When the obstruction is relieved there is a copious discharge of urine.

Incontinence of Urine.—There may be an involuntary escape of urine after labor in consequence of an overfilled bladder, of paresis in the sphincter muscle, and of a perforation communicating with the vagina or some portion of the genital tract. The first cause, the overflow of retention, should always be suspected and looked for, as it is the most common. The treatment varies with the cause of incontinence. The use of a catheter removes the difficulty in cases of the first category. Cases of the second group are more difficult to deal with. The partially paralyzed muscle, as a rule, regains its tone in a short time. It may be possible to hasten recovery in a chronic case by the administration of tonics, the use of local astringents, or, perhaps, by the application of electricity.[2] The preventive treatment should never be neglected. These cases almost invariably follow delayed and difficult labors with head presentations. A timely interference, therefore, would save the woman the discomfort, and even danger, of a constant dribbling of urine over the external genitals.[3] The repair of the urogenital trigonum muscle, which acts as a compressor urethræ, often restores continence. It is necessary in some cases after all other treatment has failed to incise the neck of the bladder, shorten the sphincter, join its ends with sutures, and to perform an operation for cystocele on the anterior vaginal wall. The author has cured intractable cases of long standing in this manner.

Cases of the third order should be managed by attempting to obtain a primary closure of the fistulous opening. This can be effected in some cases, if the fistula is not too large, by touching its edges with a strong caustic—nitric acid. If this treat-

[1] Botall, "Jour. of Obst. and Gyn. of the British Empire," 1902, p. 512.

[2] The author has restored continence by Faradism with a bipolar urethral electrode.

[3] Bechadergue-Lagrèze, "Incontinence d'Urine sans Fistule consécutive à l'Accouchement," "Thèse de Paris," 1886.

ment fails, a secondary operation for vesico-vaginal fistula is indicated.

Diseases of the Nervous System.—For the psychoses and the neuroses, see page 254.

Lesions of sacral plexuses, neuritis, and nerve degeneration from pressure during labor are usually seen in a justominor pelvis or in one with a slight projection of the promontory, which affords insufficient protection to the nerve-trunks on either side of it. Puerperal paralysis may result. Both limbs may suffer (paraplegia), or there may be unilateral paralysis, with atrophy and anesthesia. The leg or legs may be the seat of constant pain, and may be very hyperesthetic. Pressure upon the sciatic nerve or movement of the affected limb may cause agonizing pain, or there may be intense and persistent pain in the pelvis, unassociated with disease of the sexual organs. Pressure with the finger in the rectum upon the sacral plexus causes exquisite suffering. Neuritis of the pelvic nerve-trunks may be the result of pressure from exudates or of their involvement in septic inflammations. Fixation and extension of the limb give the greatest relief at first. Immobilization of the whole body in the orthopedic surgeon's wire cuirass is the most efficient means of securing perfect quiet and comfort. When the acute stage has subsided, massage, electricity, and passive movements hasten the restoration of the limb. The prognosis is fairly good. There may be, after child-birth, neuritis of nerves distant from the genital region (the ulnar, for instance). Multiple neuritis in alcoholic subjects may develop after child-birth or during pregnancy. Laury[1] makes three divisions of puerperal neuritis—traumatic, septic inflammatory by extension, and infectious neuritis of distant nerves and of the spinal cord.

Apoplexies of the Brain and Spinal Cord; Aphasia; Hemiplegia; Paraplegia.—There is a predisposition to apoplexies in the central nervous system during labor, especially in women whose vessels are diseased in consequence of insufficient kidney-excretion.

Ascending Myelitis.—I have seen an ascending myelitis first manifesting itself some two weeks after labor, the temperature having been previously normal, but becoming elevated as paralysis of the lower limbs appeared. The paralysis was progressive, and the result fatal. At the postmortem examination no starting-point in a septic focus or apoplexy could be discovered. There were simply the signs of inflammation and degeneration. It is an interesting inquiry whether this condition could have come from pressure upon the lumbosacral plexus and an ascending nerve-degeneration.

[1] "Archives de Tocol," Nov. 1, 1893.

Developmental Anomalies of the Breast.—Absence of Mammæ.—Complete absence of both breasts is one of the rarest anomalies of development. Marandel, Lousier, and Froriep [1] each report a case of entire absence of one breast, the other being well developed. Imperfect development of the mammary glands is common. It is sometimes seen to an extreme degree in cases of infantile or absent sexual organs.

Fig. 531.—Asymmetrical hypertrophy of breasts in a woman recently delivered. University Maternity.

Hypertrophy of the mammæ is also rare. Labarraque [2] collected twenty-six cases, of which only five were over twenty-six years of age. The breasts are usually asymmetrical. There is one case on record in which a single mammary gland weighed sixty-four pounds. Lactation has been known to diminish a congenital hypertrophy of the breasts. An overgrown mammary gland, therefore, is not a contraindication to suckling the child.

Supernumerary Breasts—Polymastia.—Supernumerary breasts and nipples are more common than is generally supposed.[3] Bruce found sixty instances in 3956 persons examined (1.56 per cent.). Leichtenstern places the frequency at 1 in 500. Both observers declare that men present the anomaly about twice as frequently as women. In 400 women examined in one winter in my hospital services there was 1 case of polymastia. It is impossible to account for the accessory glands on the theory of reversion, as they occur with no regularity in situation, but may develop at odd places on the body. The most frequent position is on the pectoral surface below the true mamma and somewhat nearer the middle line; but an accessory gland has been observed on the left shoulder over the prominence of the deltoid; on the abdominal surface below the costal cartilages; above the umbilicus; in the axilla; in the groin; on the dorsal surface; on the

[1] "Amer. Sys. of Gyn.," vol. ii, 338.

[2] "Thèse de Paris," 1875. "Bilateral Diffuse Virginal Hypertrophy of the Breasts." G. B. Johnston, "Tr. S. Surg. and Gyn. Soc.," 1903.

[3] "Supernumerary Breasts and Nipples." E. B. Young, "Boston Med. and Surg. Journal," March 24, 1904.

labium majus; on the buttock, and on the outer aspect of the left thigh. In cases reported by Edwards[1] and Handyside, and in some others, including one of the author's, heredity seems to have been a probable explanation for the development of the supernumerary mammæ; but in the vast majority of cases no hereditary influence can be traced.

Ahlfeld[2] explains the presence of mammæ on odd parts of the body by the theory that portions of the embryonal material

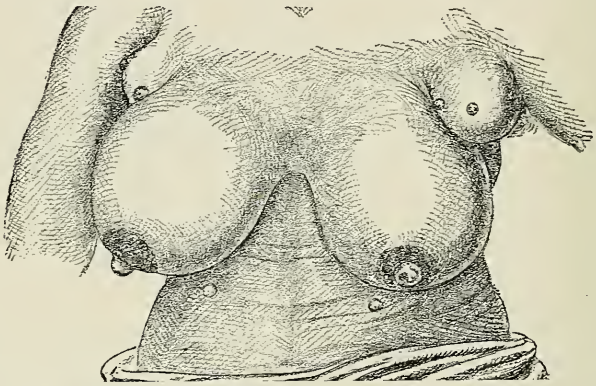


Fig. 532.—Polymastia: nine breasts and nipples. (Seen in consultation with Dr. D. E. Kercher.)

entering into the composition of the mammary gland are carried to and implanted upon any portion of the exterior of the body by means of the amnion.

The woman represented in figure 532 is remarkable for the almost unprecedented number of breasts and nipples that she possesses.[3] She has nine mammæ all told, and as many nipples, every one of which secreted milk profusely. The two normal glands are very large. The nipple of the gland in the left axilla is not shown plainly in the illustration on account of its situation, and it is not easy to see it in the woman herself, concealed as it is by the axillary hair, but when the corresponding gland in the axilla was compressed, a stream of milk was projected several feet from the woman's body.

As may be seen, the glands are arranged with some symmetry. There are five on the left and four on the right side.

The woman is a negress, nineteen years old, and a IV-para. Her child was born prematurely. Her mother had an accessory

[1] "Medical News," March 6, 1886 (good bibliography). See also Goldberger ("Archiv f. Gyn.," xlix, H. 2, S. 272), who states that there are 262 cases recorded in literature.

[2] "Missbildungen der Menschen."

[3] Neugebauer has reported a case of polymastia with ten nipples. "Centralblatt f. Gyn.," 1886, No. 45.

mamma on the abdomen that secreted milk during periods of lactation.

Anatomical Anomalies of the Nipple.—The shape of the nipple may unfit it for nursing, predisposing to injury by the child's gums, to fissure and ulcerations (see Fig. 534), or making it a mechanical impossibility for the child to take hold, as in inverted nipples (Fig. 534). The nipples should always be examined during pregnancy. If they are inverted, a systematic attempt should be made during the last month to draw them out with a breast-

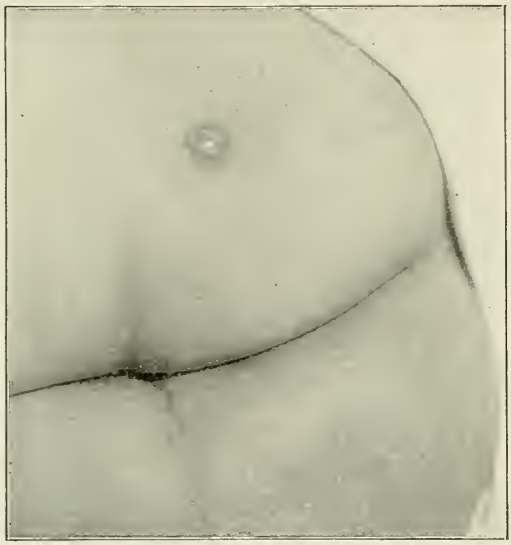


Fig. 533.—Supernumerary nipple and small mammary gland upon left buttock. It was always possible during pregnancy to squeeze out a drop of milk (author's case).

pump. Should this attempt fail, a nipple-shield might enable the child to nurse.

Abnormalities of the Breasts and Anomalies in the Milk Secretion.—Milk secretion begins usually forty-eight hours after delivery. Previous to this time a thin fluid may be squeezed from the breast, containing large cells, within which are many fat-globules. To this substance the name "colostrum" has been given, and the cells are called colostrum corpuscles. It is always difficult to estimate the exact quantity of milk secreted. The best way is to draw the milk with a breast-pump at regular intervals during the twenty-four hours ; but the breast-pump does not excite maternal emotion, and, therefore, it always draws a less quantity than would be furnished a suckling infant, for the breast

is in some degree an erectile organ, and even the sight of the child may be sufficient to produce a flow of milk. Allowing for these errors, there is found, at the end of the seventh day, about fourteen ounces in the twenty-four hours. During the five preceding days the quantity is small and variable. By the end of the fourth week the quantity of milk secreted in the twenty-four hours reaches about two pints. From this time it increases gradually until the sixth or seventh month, when about three pints of milk can be drawn from the breast in twenty-four hours. After the eighth month the quantity of milk gradually decreases. A curious anomaly of milk secretion is its occurrence independent

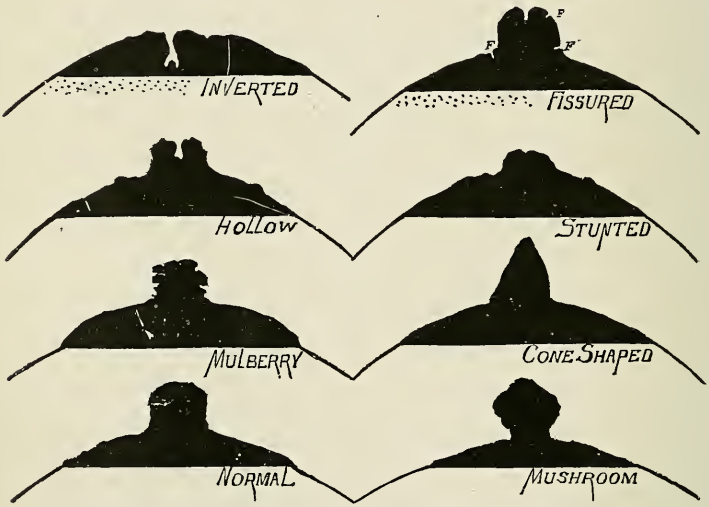


Fig. 534.—Faulty development of the nipple (Dickinson).

of the puerperal state, as in old women or young girls,[1] after operations upon the ovaries,[2] at the menstrual period,[3] or as a vicarious menstruation, in pseudocyesis, in association with pelvic and abdominal tumors, even in the adult male.[4] The most important abnormalities of milk secretion may be grouped under two main headings—quantitative and qualitative.

Deficient secretion in its extreme degree is known as "agalac-

[1] Gellhorn, "Abnormal Secretion from the Mammary Glands in Non-pregnant Women," "Jour. Am. Med. Assoc.," p. 1839, 1908.

[2] Penrose, "M. and S. Rep.," 1889, 326.

[3] Sinéty, "Traité de Gynéc.," p. 955.

[4] "John Hunter's Notes," quoted by Barnes; Humboldt, "Reise in die Æquinoctiale Gegenden des neuen Continents," Bd. ii, S. 40.

tia," complete absence of milk, which is exceedingly rare. Winckel, in an enormous experience, asserts that he has never seen an example—that there is always some little milk secretion, which may, however, escape notice without close observation. There are a few recorded cases of complete absence of the breasts. Agalactia would be a necessary consequence. Deficient milk secretion is by no means uncommon. There are many causes preventing normal activity in the mammary gland. Premature maternity may account for it. Advanced age is another cause assigned for deficient lactation. There is either atrophy of the gland or exhaustion by previous activity. The nearest approach to complete agalactia which I ever witnessed was in a woman who had her first living child at the age of forty-three. She had been married at forty, and had had previously two children still-born. There was so little milk secretion that it was scarcely noticeable.

Perhaps the most frequent cause of insufficient milk secretion is lack of development in the glandular tissue, which may be hereditary, may depend upon the continuous pressure from the clothing, or may be associated with a defective development of the remainder of the body, especially of the genital organs. Altmann [1] has called attention to the hereditary form of atrophy in the mammary gland. In parts of Bavaria, where it has been the custom for centuries to nourish the children artificially, the mammary glands no longer secrete milk. In Munich, of the women who did not nurse their infants, fifty-eight per cent. were said to be physically unable to do so. Of the women who nursed their children, seventy per cent. had to resort to mixed feeding. In other parts of Germany, on the contrary, notably in Silesia, where the custom of suckling children has been carefully observed for many generations, it is rare to find mothers with an insufficient supply of milk.

The ability of the breast to furnish milk does not necessarily depend upon its size, for a large mammary gland may consist chiefly of connective tissue, while in another apparently ill-developed the gland-tissue is abundant and the milk-supply ample. During pregnancy the glandular structure of the breasts takes on an active growth and development, while the connective tissue decreases to a marked degree. If lactation is not practised, there begins at once an involution of the gland, a shrinkage of the epithelial structures, and a regrowth of connective tissue. If involution is allowed to occur after the birth of the first child, it is more difficult after subsequent deliveries to awaken the breast to functional activity.

[1] "Ueber die Inactivitätsatrophie der weiblichen Brustdrüsen," Virchow's "Archiv," Bd. cxi, p. 318.

The mammary secretion, at first sufficient, may at times be much diminished as the result of hemorrhages or of diarrhea, in consequence of an acute febrile attack during lactation, or of

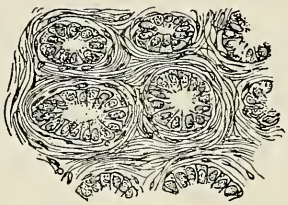


Fig. 535.—Mammary gland of a nullipara (from Silesia). × 320.

inflammation within the gland itself. Serious organic diseases may also be a cause, and insufficient nourishment must be held accountable in some cases. During the siege of Paris an obser-

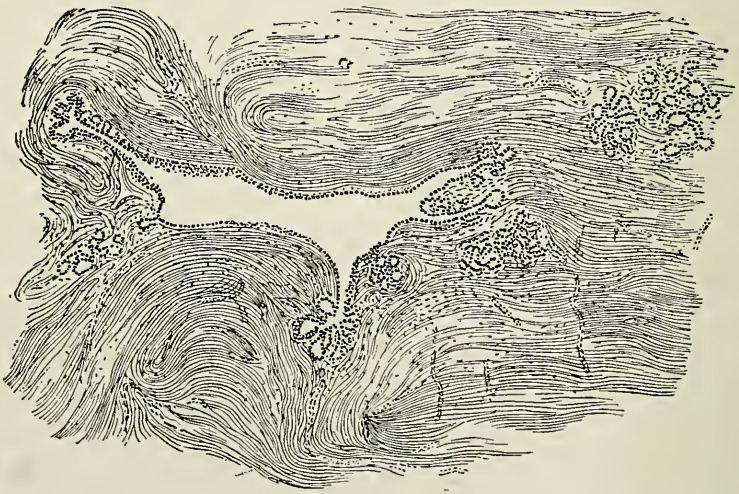


Fig. 536.—Mammary gland of a nullipara (from Silesia). × 52.

vation of forty-three nursing woman by Decaisne[1] proved that with imperfect nutrition the total quantity of the milk is much

1 "Des Modifications que subit le lait de femme pour suite d'une alimentation insuffisante; observations recueillies pendant la siège de Paris," "Comptes Rend.," lxxiii, No. 2.

decreased. Almost one-third of these women lost their children by starvation. Emotions exert an extraordinary influence upon lactation. Those which are of gradual development and long continuance, as profound grief, tend to progressively diminish the amount of milk. Emotions of sudden onset and short duration, as fright or anger, either totally stop the formation of

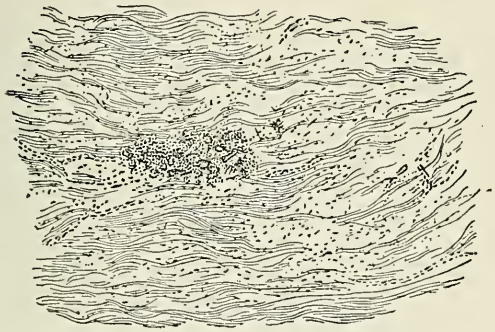


Fig. 537.—Mammary gland of a nullipara (from Bavaria). × 52.

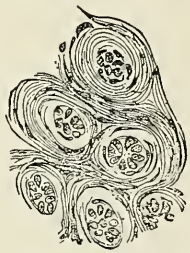


Fig. 538.—Mammary gland of a nullipara (from Bavaria). × 320.

milk, or else so alter its constitution that it becomes a rank poison to the child. The return of menstruation sometimes affects the quantity and quality of a woman's milk, but not nearly so often as is popularly supposed. Zweifel states positively that for the most part the return of the menses is without influence upon lactation. This statement is in accord with the experience of Winckel, Joux, Tilt, Becquerel, Vernois, and my own. There are a few other rarer causes to which deficient mammary secretion has been ascribed. It has been said that the exit of the milk-ducts may be obstructed by an accumulation of epithelium recognized by a minute white, projecting, translucent vesicle upon the nipple at the opening of the obstructed duct. Nasal, pharyngeal, or bronchial catarrhs are supposed to diminish the quantity of milk. The mammary gland is described in some cases as torpid. A failure to furnish enough milk is ascribed occasionally to the fact that the individual approaches the male type. The milk-supply is rarely abundant after premature delivery or the delivery of dead infants. Extreme obesity may almost entirely prevent a functional activity of the mammary gland.

Treatment.—It is obvious that no single plan of treatment will increase a deficient milk-supply. It is also apparent that in

the vast majority of cases the cause of the difficulty is beyond the influence of any treatment. One cannot alter the age of the patient nor replace deficient glandular tissue. There are some cases, however, of insufficient secretion that respond promptly to appropriate treatment. A scanty supply of milk dependent upon an insufficient diet is easily corrected. If lactation is interrupted by an acute febrile attack, nursing may be successfully resumed after convalescence is established, even though weeks and occasionally months have intervened. I have seen lactation begin a month after a difficult Cesarean section attended with profuse hemorrhage and continued successfully. In cases of general ill health or constitutional weakness, much may be effected by the administration of tonics and nutritious diet and change of air and scene. If the deficient secretion is dependent upon some emotion, the cause, if possible, should be removed. Electricity has been much vaunted as a remedy for insufficient lactation. It may be applicable in cases of torpidity of the mammary gland or in those cases in which lactation was not practised after the birth of the first infant, and in which, therefore, the mammary gland does not respond readily to the stimulus of subsequent births. This remedy, however, often proves ineffective and disappointing.

There is no medicinal galactagogue of any value. If three meals a day of food suitable to the patient's condition, reinforced by four glasses of milk between meals and fluid extract of malt at meals, will not produce a sufficient flow of milk, the child must usually be artificially fed.

Quantitative anomalies by excess in the milk secretion may take three forms. In women of a vigorous physique, well nourished, and of a full habit, the supply of milk is likely to be in excess of the infant's needs—polygalactia. Lactation may be continued far beyond the usual time—hyperlactation. In the third variety the milk continues to flow from the breasts in varying quantities and for varying lengths of time after the child has been weaned or when it has not been suckled—galactorrhea.

Polygalactia is exceedingly common. The treatment has been referred to on page 372. Its main features are compression and support of the breast by a mammary binder, the administration of laxatives, the regulation of the diet, and the evacuation of the breasts.

Hyperlactation is more frequently met with among the poorer classes. Infants are nursed far longer than they should be, either from the fact that it is difficult to provide food for another mouth or because of the prevalent belief that lactation grants immunity from impregnation. Women have been known to

nurse their children up to the second or third year. Some women and certain races do it with impunity. Spanish wet-nurses suckle three or four successive children in one family. Japanese women habitually nurse their children for five or six years. Hyperlactation, however, usually leads to serious results. The patient becomes exceedingly weak, pale, and thin. The quantity of blood is diminished—oligemia. There are loss of appetite, constant headache, pain in the back, languor, and derangement of the nervous system. Cramps in the muscles of the neck and upper extremities occur frequently; they appear often during the day and last for varying periods. Suckling the child often originates an attack. There is especial danger of phthisis in women of tuberculous tendency.

The treatment of hyperlactation is simple and effective. The child must be weaned and the mother's strength restored by a nutritious diet, tonics, and, if possible, change of air.

Galactorrhea means a flow of milk from the breasts not necessarily excited by the suckling child, and commonly continued long after the usual term of lactation. The quantity of milk excreted may vary from a few grams to seven liters in twenty-four hours.[1] Usually, both breasts are involved; sometimes only one. The cause is unknown. It has been attributed to a relaxation or paralysis of the circular muscular fibers surrounding the milk-ducts, but this is an effect and not a cause. There is a case recorded of galactorrhea in the left breast, associated with left hemiplegia occurring after child-birth.[2] The duration is long, extending often over years. There is a case reported in which, for thirty years, there was an uninterrupted flow of milk from the breasts of a woman who, at the time of the report, had reached her forty-seventh year. Curiously enough, her health had not suffered. Another anomalous feature in the case was that the return of the catamenia increased the flow of milk.[3] I have seen a woman who had had galactorrhea for eleven years after a miscarriage at the fifth month. Her health remained perfect. The usual effect of a long-continued flow of milk is unfavorable, like any other long-continued discharge. The general debility from this cause is known as "tabes lactea." The same condition may be seen in extreme cases of polygalactia and in hyperlactation.

Treatment.—The most prominent feature in these cases is the stubborn resistance that they offer, as a rule, to treatment.

[1] Winckel, "Path. u. Therap. des Wochenbettes," p. 440.

[2] "Trans. London Obstet. Soc. for 1887," xxix.

[3] Green, quoted by Gibbons, "A Case of Galactorrhea (unilateral)," *ibid.*

There are two measures, however, which can usually be depended upon to give relief—firm compression of the mammary gland and the administration internally of iodid of potassium. It should be remembered, moreover, that in many cases the milk secretion stops spontaneously with the return of menstruation,[1] and that in a certain proportion of cases a treatment adapted to securing a discharge of blood from the uterus has been successful in curing galactorrhea. Abegg was successful in two instances in stopping the galactorrhea by the use of warm douches, which brought about a return of the menses. The intra-uterine application of the negative pole of a galvanic current, 10 to 12 milliampères, is the best treatment to bring back the menstrual flow. Electricity has been recommended to secure the proper contraction of the sphincter muscles of the lactiferous ducts. The long-continued administration of ergot has been successful, and its use is rational. The experiments of Roehrig[2] have demonstrated that drugs causing an increased arterial pressure in the breasts promote milk secretion, while those lowering arterial tension tend to diminish or even abolish the function. Chloral was shown to be peculiarly powerful in diminishing the quantity of milk; therefore, this drug is also worthy of a trial. Belladonna internally, or as a local external application, is usually employed as a routine practice, but is of doubtful utility. It has been claimed that antipyrin, in 2½-grain doses, three times a day, diminishes milk secretion.[3]

Qualitative Anomalies in the Milk.—The most important factor influencing the constitution of the milk is the diet. A fatty diet diminishes the quantity of milk. A vegetable diet diminishes the casein and fat, and increases the sugar. A diet rich in meat increases the fat and casein, but diminishes the sugar. A scanty diet diminishes all the solid constituents of the milk except the albumin.

The commonest anomaly in the constitution of the milk, in my experience, is a deficiency of fat and an excess of casein. In one of my patients, in each of three confinements there has been a milk of only 0.8 per cent. fat and 3 per cent. albuminoids. Usually this disordered condition of the milk can not be remedied. In a few instances, however, qualitative anomalies may be corrected by dietetic management.

The effect of emotions upon the constitution of the milk has

[1] Gibbons' case; Abegg's cases; in two cases, under the care of Depaul, the galactorrhea was arrested by the recurrence of pregnancy.

[2] Quoted by Gibbons.

[3] "Bull. gén. de Thérap.," June, 1888.

already been referred to. Baranger[1] quotes a good example: A nursing woman saw her husband threatened by a soldier armed with a saber. Directly afterward she gave suck to her child. It seized the nipple at first with avidity, then refused it, became violently convulsed, and died. Every practising physician has seen, at least to some degree, examples of the change produced in the milk by mental impressions. Becquerel and Vernois found that under the influence of emotion the milk of a woman contained more water, very much less fat, and somewhat more casein than was found in the mammary gland of the same individual under ordinary circumstances. Almost all acute febrile affections not only diminish the mammary secretion, but produce some change in its constitution and make it indigestible. This is most marked in the prodromal period. If a chill occurs, the lacteal secretion is suspended almost entirely for from twelve to twenty-four hours.

The germs of some diseases pass from the mother's organism into her milk; this is undoubtedly true of tuberculosis. It is probable that the germs of malaria find an exit from the body in this way. Septic micro-organisms may contaminate the milk from the breast, although the mammary gland itself is free from inflammation. Karlinski[2] has reported a fatal infection of the new-born from the milk of a puerpera with septic fever. Staphylococci were found in the milk.

Women under the influence of mercurialism or saturnism excrete milk of abnormal quality, dependent, perhaps, as much upon the anemia associated with these conditions as upon the excretion of the drug itself. The influence of syphilis upon the constitution of the milk is not yet known. It has been asserted that there is no change in the milk of syphilitic women. Vernois and Becquerel, on the other hand, affirm that there are well-marked alterations in the relative proportions of the different ingredients in the milk from syphilitic women.

Under ordinary circumstances colostrum-corpuscles may be detected in human milk for the first eight or ten days after delivery. There are certain conditions in which a return of these corpuscles may be noted. They reappear sometimes upon the return of menstruation, during acute mastitis, or in any other acute affection during lactation. Of twenty-three examinations made by Truman[3] to investigate this point, colostrum-corpuscles were found present in the following cases: In a primipara for

[1] "Les Contre-indications et Obstacles à l'Allaitement maternal," "Thèse de Paris," 1884.

[2] "Zur Ætiologie der Puerperal-Infektion der Neugeborenen," "Wien. med. Wochenschr.," 1888.

[3] "British Med. Jour.," 1888, ii, p. 947.

four weeks after the birth of a premature infant; in a woman who was suckling her four-month-old baby; in a non-pregnant woman whose infant, born twenty-six months before, had been weaned for ten months; in a non-pregnant woman who had been married three and a half years; ever since marriage, for a week before menstruation, the breast filled with milk, in which were colostrum-corpuscles; in a nursing woman who had never been able to use her right breast during lactation. Her last child was twelve months old. In the milk which could be squeezed out of the right breast colostrum-corpuscles were discovered. Another case was one of chronic ovaritis. Twenty-three months had elapsed since the last labor, and eleven since weaning. The milk which exuded from the breast contained colostrum-corpuscles. In the breast of a woman fifty-six years old, which was removed for carcinoma, about a teaspoonful of milk was found, very rich in colostrum-corpuscles. This woman's youngest child was eight years old. In a case of galactorrhea which had persisted for four years these bodies were also discovered. The presence of colostrum-corpuscles in the milk is not a proof, therefore, of a recent delivery.

Anomalies of Color.—Blue milk is due to the presence of the bacillus pyocyaneus; yellow and green milk are also due to micro-organisms. Red milk may be the result of infection by the micrococcus prodigiosus, or blood may be excreted by the gland, as a vicarious menstruation or as a symptom of a malignant tumor.

Diseases of the Mammary Glands.—Areola.—The glands of Montgomery may be inflamed, and their infection may lead to mammary abscess.

Treatment.—Infection of the areolæ should be avoided by cleanliness. Each inflamed and suppurating gland should be opened, curetted, and its interior touched with strong bichlorid solution.

Exaggerated pigmentation of the areolæ often persists after pregnancy; it fades away in the course of lactation or after the child has been weaned.

Congestion and engorgement of the mammæ occur in almost every case on the third day, when lactation is instituted.

Treatment.—Excessive congestion may be avoided by administering a saline purge on the evening of the second day. The breasts must be thoroughly evacuated at regular intervals by the child's mouth, reinforced, if necessary, by massage[1] and a breast-

[1] Bacon claims that mammary massage to empty the breasts is a mistake; that it should be conducted like massage of a swollen joint to stimulate the blood and lymph circulation. My nurses, however, tell me that the method described and illustrated in the text proves more satisfactory than a breast-pump. Massage of the breasts does improve the circulation, but it also empties the breast. See "American Journal of Obstetrics," vol. xlv, No. 6, 1902.

No. 1.—Light circular stroking movement from the base and periphery of the breast toward the nipple.

No. 2.—Outer side and base of breast supported by left hand. Light digital kneading in small circles, from the periphery toward the nipple, by the right hand.

No. 3.—Inner side of breast supported by right hand. Same light digital kneading with left hand as in No. 2.

No. 4.—Deep pressure from base toward nipple, with circular movements of finger-tips at base. All movements must at first be light, increasing in vigor as the breast softens. Oil should be plentifully applied to the skin of the breast, and stroked in with the first movement.

Fig. 539.—Massage of the breasts.

pump. Hot fomentations may give great comfort; but if the congestion and pain persist, lead-water and alcohol is the best application. A mammary binder is almost always a necessary part of the treatment. The pressure and support which it affords contribute more than any other single item in the management of these cases to prevent excessive congestion and disgorgement.

From the investigations of Honigmann[1] and Ringel,[2] it appears that human milk contains normally the staphylococcus pyogenes albus, as well as the staphylococcus aureus. These micro-organisms wander in along the milk-ducts from the skin. They produce, usually, no ill results, unless the vitality of the epithelial cells is reduced by engorgement of the gland with milk

Fig. 540.—Breasts disfigured by exaggerated pigmentation of the areolæ.

and blood, as in the "caked breast." They may then take an active part in the development of a mammary abscess, by attacking the epithelial cells of the milk-ducts, destroying them, and invading the surrounding connective tissue.

Sore Nipples.—Excoriations and fissures of the nipples are due to the maceration and irritation to which they are subjected by the child's gums and mouth. Mammary abscess not infrequently results from the entrance of streptococci or of other infectious bacteria through these fissures.

Prophylactic Treatment.—During the latter months of pregnancy the nipple should be washed twice a day, and should then

[1] F. Honigmann, "Bakteriologische Untersuchungen ueber Frauenmilch," Inaug.-Diss., Breslau, 1893.

[2] Ringel, "Ueber den Keimgehalt der Frauenmilch," "München. med. Wochenschr.," 1894, No. 27.

be touched with a piece of clean absorbent cotton, saturated with a mixture of glycerol of tannin and water, equal parts. Alcoholic astringents should be avoided. It is necessary to keep the nipple clean during lactation by bathing it after each nursing with boric acid solution (gr. x to f℥j), and to keep the skin

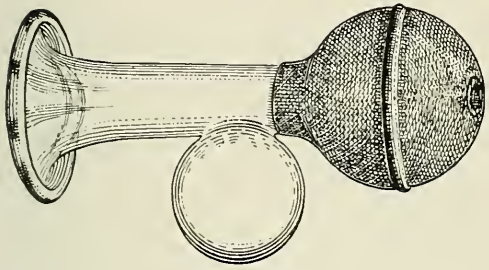


Fig. 541.—Breast-pump.

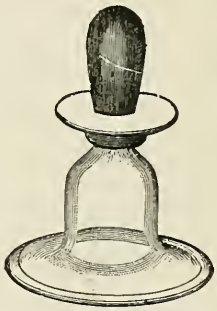


Fig. 542.—Nipple-shield.

in a healthy condition by frequent applications of sweet-oil, until the nipple becomes accustomed to its functions.

Curative Treatment.—The nipple should be carefully cleansed after each nursing, and one of the following remedies should be applied to it: An ointment composed of ʒij each of bismuth subnit. and castor oil; tinct. benzoin comp., applied directly to the fissure. Iodoform, gr. x, to ung. zinci oxidi, ℥ss; ichthyol, ʒj; lanolin, glycerin, each ʒiss; olive oil, ʒiiss. The fissure may be touched with a solution of nitrate of silver (gr. x to the ounce) or with the solid stick. A nipple-shield is almost always necessary. It must be perfectly clean, and should be kept immersed in cool water while not in use. In cases of supersensitive nipples, without abrasions or cracks, or if the latter are slight in degree, extract of witch-hazel is an excellent remedy. It is often advisable to protect the nipples between the nursings by lead nipple shields, which guard them against the rubbing of clothing or of the mammary binder. Occasionally the nipples are so exquisitely sensitive that the pressure of a night-gown or of the bed-clothes is unendurable, although there is no fissure, crack, abrasion, or inflammation. In such cases nerve-sedatives internally, lead nipple shields, and cocain as a local application are necessary. Usually, the child must be weaned.

Inflammations of the Breasts—Mastitis.—There may be an inflammation of the subcutaneous connective tissue of the mam-

mary gland, of the deeper interstitial tissue, or of the parenchyma. A septic inflammation is rarely confined strictly to one of these localities. There is usually involvement of all the tissues in the gland.

Fig. 543.—Puerperal mastitis forming abscess: *a*, Group of acini melted to pus (Billroth).

As in all puerperal infections, the micro-organisms responsible for the inflammation may be of many pathogenic varieties. The constitutional symptoms of mammary infection are usually slight, but may be very severe, even though the local inflammation appears to be moderate.

Causes.—The first two classes, superficial and interstitial mastitis, are due to sepsis, the result of direct inoculation. The sources of infection are unclean fingers, contaminated water, soiled rags to dry the nipple, dirty cloths laid over the breasts, and stomatitis in the infant. Parenchymatous inflammation need not always be ascribed to this cause. Overactivity of the gland, engorgement with blood, and distention with milk (the so-called "caked breast") may be primarily responsible for the infectious inflammation by weakening the resisting power of the cells against microbic invasion.

Treatment.—If the inflammation is parenchymatous and is due to oversecretion, the breast must be emptied with a pump or by massage (see Fig. 539), and must be supported by a binder. If the inflammation is confined to the connective tissue and suppuration is threatened, lead-water and alcohol should be applied with a mammary binder. Suckling had best be intermitted if the inflammation continues and an abscess is threatened, as the irritation of nursing may increase the mammary congestion and the milk is apt to disagree with the child. It has rarely given rise to septic infection of the child's intestines by its contained micro-organisms.

Bier's treatment of local hyperemia by a vacuum apparatus (Fig. 544) has been highly recommended in congestion and threatened suppuration of the breast. I gave it a thorough trial for a year with unsatisfactory results. It is painful and no more efficient than the measures described above.

Mammary Abscess.—The pus may be located superficially, in the gland-substance, or in the submammary connective tissue, as a postmammary abscess.

The symptoms of suppuration are uncertain. The reddened skin, the swelling and sensitiveness of the breast, and the fever may be due simply to intense congestion. Fluctuation is rarely detected until late, and should not be awaited. A dusky-red hue

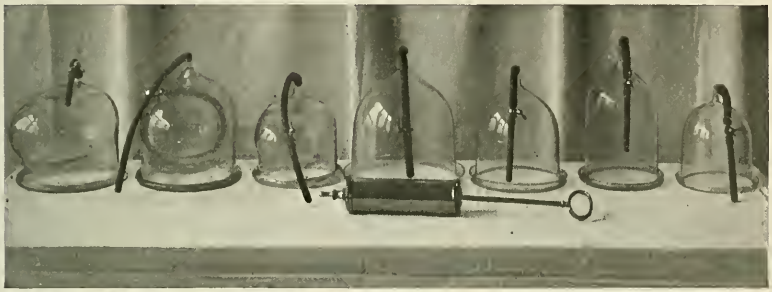


Fig. 544.—Various sizes and shapes of Bier's cups for the breast, with the syringe, to create a vacuum.

of the skin, and edema, with fever, are the most valuable signs of suppuration, and should indicate an immediate incision or incisions.

Treatment.—A mammary abscess must be incised as soon as the physician is satisfied that there may be pus within the breast. It is much better to make an unnecessary incision than to allow the pus to burrow through the gland until the operation for the woman's relief becomes quite formidable. If the abscess is opened early, one incision commonly suffices. If the case is neglected, every pocket of pus must be opened and every sinus must be drained to secure a prompt and permanent cure. I have made as many as eighteen incisions in the two breasts, and have had half that number of drainage-tubes through the glands in a woman who had been ill for six weeks or more with mammary abscesses, in spite of a few ineffective and insufficient incisions in the breasts, made from time to time by her medical attendant. In incising a mammary abscess, the incisions, so far as possible, should radiate from the nipple, so that they run parallel with the lacteal ducts. Otherwise, a duct may be cut across and

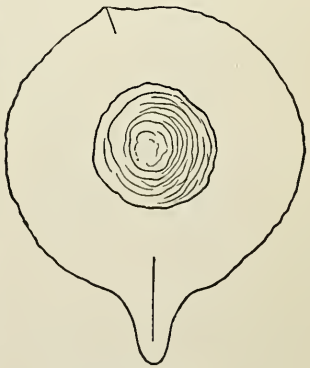


Fig. 545.—Pigment of the areola following incisions (Richardson).

a lacteal fistula may result. The incision should, if possible, avoid the area of pigmentation, or should be confined wholly within it, as the pigmentation follows the cut, disfiguring the breast (see Fig. 545). The incisions should be made through the skin with a knife, the opening being only large enough to admit a moderate-size drainage-tube. The abscess-cavities should be punctured with a hemostat, inserted closed and withdrawn open. After evacuating the pus and inserting the drainage-tubes, which are pulled through from one opening to another by dressing-forceps, the breast is covered with sterile gauze and is compressed by a firm mammary binder. The drainage-tubes

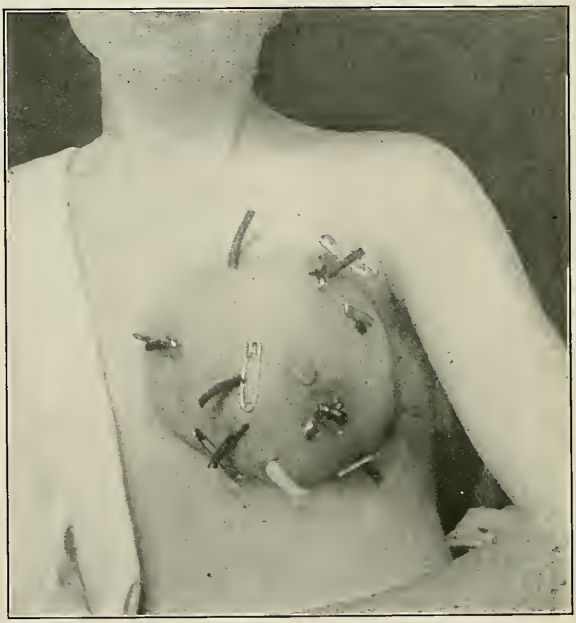


Fig. 546.—Drainage required in a case of mammary abscess.

should be irrigated with sterile water daily by a straight-tipped medicine-dropper attached to a fountain syringe and inserted in the end of each tube. The average time for convalescence is two weeks. It is claimed that Bier's apparatus is an effective and quick means of evacuating mammary abscesses through one or more small punctures. The usual rules for the application of this apparatus are followed: forty-five minutes at a time, four minutes on, four minutes off. I tried it in a number of cases, but

in each instance was obliged to give it up in favor of multiple incisions and counter-drainage.

In the case of **postmammary abscess**, the whole breast is lifted off the chest, and there are no signs of suppuration within the gland itself. The systemic symptoms of this kind of mammary abscess are usually severe.

Treatment.—The incision should be made beyond the periphery of the gland at the most dependent part as the woman lies on her back, and a counteropening must be made upon the opposite side. A drainage-tube is passed under the gland by a dressing-forceps, and the cavity is irrigated daily.

A **galactocele** is a milk-tumor due to occlusion of one of the lactiferous ducts. It is usually of no pathological importance, unless it should, as rarely happens, reach a large size, when it must be tapped and drained.

Other **mammary tumors,** especially adenomata, may take on a very rapid growth in pregnancy, and may become so engorged and painful when lactation begins that their removal is necessary. In one of my cases an adenoma grew during pregnancy from the size of a walnut to that of a cocoanut, and I was obliged to excise it on the third day of the puerperium.

Relaxation of the Pelvic Joints.—The pelvic joints, after labor, may be the seat of inflammation, accompanied by serous exudation, and ending possibly in suppuration. In the case of the symphysis pubis, the abscess can easily be opened and drained. The prognosis, therefore, is good. In the other pelvic joints suppuration is commonly fatal. The pelvic joints may be ruptured by violence during labor. This accident is considered in connection with the forceps operation and injuries to the woman in labor. Finally, there may be relaxation of the pelvic joints to a marked degree, much exaggerated beyond that seen in almost every pregnant woman, and persisting after delivery.

The *etiology* is obscure. Abnormal motion in the pelvic bones has been seen in justomajor pelves. It has been noted after abortion. It may be traced to a large, hard fetal head which had stretched the joints. It occurs in justominor pelves rather frequently. It has been ascribed to obesity, to a cachectic condition, to sudden and powerful exertion in the latter months of pregnancy, to an unusually great circumference of the pregnant uterus,[1] and to previous disease or abnormality of the joint.[2]

The *diagnosis* is easy. There is difficult locomotion, unusual mobility in the joints, especially the symphysis pubis, and localized pain. The woman may not be able to stand on her feet at all, or to take a step without collapsing. The examination is

[1] Winckel, "Geburtshülfe," p. 873.
[2] Schauta, in Müller's "Handbuch," vol. ii.

best made in the erect posture, the physician placing a forefinger behind and his thumb in front of the symphysis. As the patient takes a step forward and backward the abnormal mobility of the innominate bones is appreciable. If the woman cannot stand, the examination is made in the dorsal position, an assistant flexing, extending, abducting, and rotating one thigh.

The *treatment* is rest in bed with the application of a firm binder about the hips reinforced sometimes by sand-bags. In the course of a few weeks the joints usually become firm. Occasionally, the relaxation persists for months. I have not yet seen a case that did not recover under the treatment described :. Kelly reports one in which he resected the symphysis and wired the pubic bones together.

CHAPTER II.

Puerperal Sepsis.

Historical.—The history of the acquisition of our knowledge of puerperal infection is distinctly modern. It had its earliest beginning about fifty years ago, and dates back in reality scarcely thirty years. Indeed, one may say that a true comprehension of the causes and nature of puerperal sepsis was acquired only at the close of the nineteenth century, and that the past few years have contributed more information on the subject than all the previous ages of medicine.

The history of medical views on the septic fevers of the puerperium prior to the past generation is a long record of error and ignorance. From the earliest beginning of medical literature to the nineteenth century, puerperal sepsis was ascribed to suppression of the lochia. This belief was not questioned until 1670, when Puzos advanced the theory that all puerperal fevers were due to a metastasis of milk, which flowed in the blood during pregnancy, and was normally attracted to the breasts after delivery, but which might be drawn to other organs or structures, especially the peritoneum, with disastrous results. This theory found support in the reports of a number of post-mortem examinations, stating that milk had been discovered in the peritoneal cavity after deaths following childbirth.

A little later English and German observers explained the puerperal infectious fevers by attributing them to inflammations

of the womb and of the peritoneum, without accounting satisfactorily for the occurrence of the inflammation. Occasionally, one finds a reference to putrid fevers in the puerperium, a suggestion that putrefying animal matter may occasion disease in human bodies with which it comes in contact, an intimation of the contagiousness of puerperal fever; but these were mere glimmerings of light that flickered out at once without illuminating the general ignorance. Credit, however, must be given to some of the English writers of the first half of the nineteenth century for insisting upon the contagiousness of puerperal fever.

Three events laid the foundation of our present knowledge of puerperal sepsis: The publication of Oliver Wendell Holmes' paper on "The Contagiousness of Puerperal Fever," in 1843; the observations of Semmelweiss in the Vienna Hospital, 1846–'48; the publication of Sir James Y. Simpson's paper on "The Analogy between Puerperal and Surgical Fevers," in 1850.

The first of these papers must always remain a classic in medical and English literature. It ended with these words:

"I have no wish to express any harsh feeling with regard to the painful subject which has come before us. If there are any so far excited by the story of these dreadful events that they ask for some word of indignant remonstrance to show that science does not turn the hearts of its followers into ice or stone, let me remind them that such words have been uttered by those who speak with an authority I could not claim.[1] It is as a lesson rather than as a reproach that I call up the memory of these irreparable errors and wrongs. No tongue can tell the heart-breaking calamity they have caused; they have closed the eyes just opened upon a new world of love and happiness; they have bowed the strength of manhood into the dust; they have cast the helplessness of infancy into the stranger's arms, or bequeathed it, with less cruelty, the death of its dying parent. There is no tone deep enough for regret, and no voice loud enough for warning. The woman about to become a mother, or with her new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law, brought down upon its victim by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in the hour of peril. God forbid that

[1] Dr. Blundell and Dr. Rigby, in the works already cited.

any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly, or selfishly!"

This unanswerable arraignment of the prevailing views in America in regard to puerperal sepsis fell upon deaf ears. The very men who should have first recognized its truth opposed the new doctrine with all their might, because it contradicted their teaching. At that time, in America, two men were so pre-ëminent in obstetrics that they were practically without rivals, and autocratically dictated their views to a large number of unquestioning followers. They were Hodge and Meigs, holding, respectively, the Chairs of Obstetrics in the University of Pennsylvania and in the Jefferson Medical College.

Meigs directed against Holmes' teaching all the satire and ridicule of which his brilliant mind was capable, descending often to undignified abuse; Hodge inveighed against it with a ponderous invective. But in spite of this powerful opposition the doctrine of the contagiousness of puerperal fever made rapid headway, and gained from year to year an increasing number of converts in America and in England. Hodge's immediate successor, Dr. Penrose, taught it most impressively.

In 1846, Ignaz Philipp Semmelweiss, a young assistant in the Maternity Department of the General Hospital of Vienna, was struck with the frightful mortality in one of the maternity wards, while in a neighboring ward the death-rate was scarcely one-tenth as great. He discovered that in the first ward the women were attended by students who were in the habit of coming fresh from postmortem examinations in the Pathological Department to the bedside of the parturient patients. In the second the women were attended solely by midwives. Semmelweiss conceived the idea that the students carried on their hands putrid products from the postmortem table to the lying-in women whom they examined, and that these products were responsible for the large number of fatal inflammations and fevers following their work. He consequently ordered that no student should examine a woman until he had washed his hands in chlorin-water. The results were fairly startling, as is shown in the accompanying table:

	Confinements.	Deaths.	Per Cent.
1846, ...	4010	459	11.4
1847, ...	3490	176	5.
1848, ...	3556	45	1.27

It should be stated that the rule compelling the students to wash their hands in an antiseptic solution was put into effect in the middle of the year 1847.

Semmelweiss recognized the transcendent importance of his

discovery. He foresaw something of the lives preserved, the homes kept from bereavement, the mothers saved to their children, the wives to their husbands, in millions of families; the incalculable diminution of human suffering which his discovery promised to the world; but his was not the calm and confident soul of a Harvey, wise enough to know that the truth is mighty and shall prevail: sure that mankind must accept it some day, and content to bide his time. Semmelweiss' nature was not great enough for such patience. He fumed and fretted his life away in vain efforts to obtain recognition for his principle of chemical disinfection. He preached his new doctrine in season and out of season, endeavoring to impress it upon his immediate colleagues, and upon the medical societies and periodical medical literature of the time in Europe. During the latter days of his professorship in Buda-Pesth he would even stop acquaintances upon the street to importune them with his views. But he got for his pains nothing but ridicule, contumely, opposition, or indifference. He finally lost his mind entirely, from chagrin and disappointment, ending his life in a lunatic asylum in Vienna, where he died, strangely enough, from a septic wound on his finger, received during an operation performed just before his commitment to the asylum.

More than twenty years after Semmelweiss' discovery, the mortality of many lying-in hospitals in Europe remained as high as ten per cent. Then came the brilliant work of Pasteur in the field of bacteriology, the acceptance of the germ theory in disease, the application of antisepsis to surgery by Lister, and the adoption of the system almost immediately by obstetricians. From that day to this there has been a steady and increasingly rapid acquisition of knowledge of the etiology of septic infection, and of its most successful preventive and curative treatment.

It is to be hoped that the medical world of to-day and of the future can never again be deaf and blind to such an appeal as that of Holmes, or to such a demonstration as that of Semmelweiss.

Etiology.—It has become necessary to study the normal and abnormal microbic flora of the vagina in order to understand fully the etiology of puerperal infection, and to comprehend the safeguards that nature affords a woman against infection after labor.

The effective study of the subject dates from Döderlein's monograph published in 1892.[1] Before this time the presence of bacilli in vaginal secretions was noted by Hausmann, Gönner,

[1] "Das Scheidensekret und seine Bedeutung für das Puerperal-Fieber," Albert Döderlein, Leipsic, 1892.

Bumm, Winter, and Steffeck. Gönner, in 1887, found in vaginal secretions many varieties of micro-organisms, mainly, however, bacilli, which were extremely difficult to cultivate in the ordinary culture media. The cocci in the secretions, many of which could be cultivated with ease, were found to be non-pathogenic.

Gönner concluded that the vaginal secretions contained no pathogenic bacteria.

Bumm also failed to find pathogenic germs in the vagina.

Winter believed that pathogenic germs were present in the vagina in a state of lessened or absent virulence.

Döderlein examined the vaginal secretions of 195 pregnant women. In these examinations notice was taken of the macro-

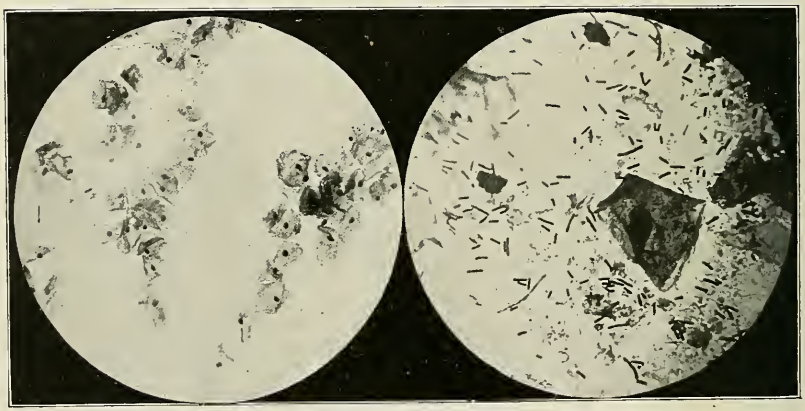


Fig. 547.—Vaginal secretion of an infant (Döderlein).

Fig. 548.—Vaginal secretion of a virgin (Döderlein).

scopical appearance and of the reaction of the secretions, and as the result of this preliminary examination the secretions were declared to be normal or abnormal. In the two conditions the bacteriological find was quite different. In the normal secretion, which was of whitish color, of the consistency of curdled milk, unmixed with mucus, containing epithelial cells and mucous bodies, moistened by an exudate from the vaginal mucous membrane and of an intensely acid reaction, there was found almost exclusively a certain kind of bacillus possessed of distinctive and characteristic qualities. No pathogenic germ was ever found by Döderlein in normal vaginal secretions, except a thrush-fungus which is capable, to a very limited extent, of producing suppuration and destruction of tissue when injected under the skin or

into the eye of an animal. In the pathological abnormal secretion, which was yellowish or greenish in color, of the consistency of cream, weakly acid or alkaline in reaction, mixed with mucus, containing often bubbles of gas and secreted usually in very large quantities, the greatest variety of cocci and bacilli could be found.

Of the 195 pregnant women, Döderlein found that 55.3 per cent. had normal and 44.6 per cent. had pathological secretions.

Although a number of observers had found bacilli in the vaginal secretions before Döderlein, no one had so carefully studied their characteristics, functions, and cultivation; so that they are properly called the vaginal bacilli of Döderlein. They are, according to him, anaërobic. They have no motion. They produce by their life-process an acid medium by forming lactic

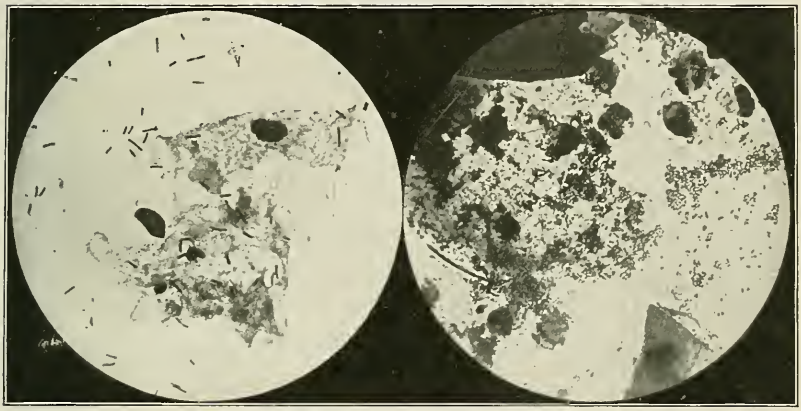


Fig. 549.—Normal secretion of a pregnant woman (Döderlein).

Fig. 550.—Pathological secretion of a pregnant woman (Döderlein).

acid. They are frequently associated with a yeast-fungus (thirty-six per cent. in normal secretions only), which Döderlein believes to be identical with the thrush-fungus, Saccharomyces albicans.

The vaginal bacilli are antagonistic to staphylococci, which within certain limits they have the power to destroy. This was shown by several experiments, among others by infecting the vagina of a virgin with staphylococcus cultures in large quantities. Within four days the staphylococci had disappeared, and no bacteria remained within the vagina except the vaginal bacillus.

Döderlein attributes the germicidal action of the normal vaginal secretion to the production of an acid environment by

the vaginal bacillus. He supports this view by the following facts :

1. That all pathological secretions swarming with saprophytes and with many pathogenic germs are weakly acid or alkaline.

2. That in a puerpera the vaginal bacillus disappears and in its place are found many kinds of saprophytes, the lochial discharge being alkaline.

3. That when the lochia ceases the saprophytes disappear, the vaginal bacillus reappears, and the vaginal secretion becomes again intensely acid.

In only 8 out of the 195 cases examined were streptococci found, and in only 5 of these cases was it possible to demonstrate by inoculation experiments that the streptococci were virulent. In 2 cases the streptococcus possessed no virulence at all.

These discoveries of Döderlein have not been universally accepted. His views have not gone unchallenged, and further interesting properties of the vaginal secretions have been pointed out by others, but we may safely acknowledge Döderlein's conclusions to be correct in the main, so far as they go, and that his discoveries constitute the most important advance in the knowledge of this subject achieved by a single individual.

Following Döderlein's investigation there have appeared a number of exhaustive studies, the most important conclusions of which may be briefly summarized as follows :

In series of examinations conducted by Burgubru, Williams, Stroganoff, and Burkhardt, in 12, 15, 9, and 16 cases respectively, streptococci were found in 1, 3, 2, and 5. Taking the sum-total of all these cases with Döderlein's, streptococci were found twenty-seven times in 542 women examined, showing that in only a small proportion of cases are dangerous pathogenic germs to be found in the vaginal secretions of pregnant women ; and accepting Döderlein's results as correct along with those of Winter, in the few cases in which streptococci were found, a considerable proportion of the streptococci were non-virulent.

Krönig,[1] in about 200 examinations, found that the vagina in pregnant women, aside from the gonococcus and the thrush-fungus, contained no pathogenic micro-organisms. The streptococcus was not found in a single case. Adding these examinations to the former series, the proportion of cases in which the streptococcus may be found is, as appears, still further reduced.

[1] "Deutsche med. Wochenschr.," 1894, Oct. 24, p. 819.

Moreover, Krönig found, after inoculating the vagina with pure cultures of streptococcus, staphylococcus, and bacillus pyocyaneus, that none of these micro-organisms could be discovered after eleven to twenty hours.

Krönig attributes the germicidal properties of the vagina, which are demonstrated by these observations, mainly to the flow outward of the vaginal secretions, and not to any special microbe having its normal habitat in the vagina. According to this observer, acid, neutral, and alkaline secretions all have germicidal power. Further, Krönig found that if an hour after the infection of the vagina an antiseptic douche of lysol were administered, not only were the infecting micro-organisms not destroyed by the douche, but also that it took the vaginal secretions from nineteen to thirty-six hours to destroy microbes that without the douche would disappear in from eleven to twenty hours.

These results were confirmed by Menge,[1] in a study of the germicidal power of vaginal secretions in non-pregnant women, except that Menge occasionally did find streptococci in the vagina. From a number of observations and experiments this observer forms the following conclusions as to the causes of the germicidal power of vaginal secretions, putting them down in the order, as he believes, of their importance:

The antagonism of the normal microbic flora of the vagina and of the pathogenic micro-organisms which may be deposited there by accident.

The products of the life-process of the vaginal bacilli.

The acidity of the secretions.

The germicidal powers of the anatomical elements of the vagina.

The leukocytosis which is provoked by chemotaxic action either of the vaginal discharges or of the infecting micro-organism invading the vagina.

The phagocytosis following leukocytosis.

The absence of free oxygen in the vagina.

Walthard,[2] from the bacteriological study of the vagina in 100 women *ante et post partum*, concludes that the genital canal of women is divided practically into two parts—one infected, the other sterile. The former comprises the vestibule, the vagina, and lower portion of the cervical canal. The latter, the upper portion of the cervical canal, the uterine cavity, and the tubal canals. The causes of this division of the canals, according to Walthard, are:

1. The plug of mucus stopping up the cervical canal, which, though not in itself germicidal, is deficient in albuminoids and furnishes no nutriment for micro-organisms.

[1] "Deutsche med. Wochenschr.," 1894, Oct. 24, p. 819.
[2] "Archiv f. Gyn.," vol. xlviii, p. 201.

2. The leukocytes, which are found in great numbers where the cervical secretion mixes with the vaginal secretion at the level of the external os.

According to this observer, there are really three divisions of the genital canal: one, the lower, containing leukocytes and bacteria; the next, containing only leukocytes, and the third, the upper, containing neither leukocytes nor bacteria.

It is supposed that the outpour of leukocytes is due to a chemotactic action excited by the mixture of cervical and vaginal discharges, and that the phagocytosis follows naturally the leukocytosis.

In the vaginal discharges Walthard found, both during pregnancy and after delivery, pathogenic microbes, streptococci, staphylococci, gonococci, and the colon bacilli. The first named were found in 27 out of the 100 women examined, but these streptococci had lost all virulence and had become veritable saprophytes. Inoculation experiments with them produced no results—that is, if they were inserted in normal tissues; but if a certain region of the animal's body was reduced in vitality, or if the condition of the animal's system was lowered in any way, the inoculation of the streptococci produced abscesses in which the micro-organisms rapidly regained all their original virulence until they became quite as deadly as the most dangerous of their kind. From his experiments and observations, Walthard draws the following conclusions:

The virulence of vaginal streptococci of a pregnant woman not examined for some time is equal to that of the streptococci that live upon other mucous membranes or in their secretions. In other words, the vaginal streptococci are not virulent, and behave as saprophytes upon healthy tissues; but as in the case of the intestinal streptococci, the vaginal streptococci can become infectious when the resistance of the tissues with which they are in contact is diminished. The virulence that the vaginal streptococci attain under these circumstances is quite equal to that of the streptococci of puerperal infection.

Stroganoff,[1] from an examination of eleven pregnant women, supports Döderlein's assertion that the vaginal bacillus produces by its development lactic acid, and shows that, while the vaginal secretions of the new-born are very weakly acid, they become more and more acid as bacteria develop in the vagina. He quotes experiments of Schlutter, showing that an acid medium retards the growth of the staphylococcus and is destructive to the streptococcus of erysipelas. He further shows, by experiments with culture media, that the vaginal bacillus produces not only an acid medium, but also other products of its

[1] "Monats. f. Geb. u. Gyn.," Bd. ii, p. 381.

life-processes that retard or prevent the growth of the staphylococci.

In these experiments the vaginal bacillus was cultivated, and the culture then raised to a high temperature, so that the bacilli were destroyed. The culture was then inoculated with the staphylococcus pyogenes albus, with negative result. If the culture, in addition to being treated as described, was made alkaline, the staphylococci grew, but not so vigorously as upon the same culture medium in which the vaginal bacillus had not been grown.

Stroganoff explains the sterility of the upper cervical canal and of the uterine cavity by the active germicidal properties of the cervical mucus, by the mechanical action of the flow of menstrual blood, by the same action of the descending placenta and membranes, and by that of the lochial discharge. Perhaps there should be added the germicidal effect of blood itself, which property it has been recently demonstrated that blood possesses, to a certain extent.

Stroganoff announces the following conclusions from his study: One finds in the vagina of pregnant women always a quantity of micro-organisms. The prominent form in normal cases is the bacillus, but there are, in addition, usually other forms present. Micro-organisms which liquefy gelatin are met with comparatively seldom in normal cases, and then only in small numbers. A pathological condition of the vaginal mucous membrane alters the normal flora. The vaginal secretion of pregnant women is strongly acid in reaction. In addition to micro-organisms, one sees usually under the microscope epithelial cells and isolated white blood-corpuscles. The cervix contains normally no micro-organisms. When they are present in that situation, their number is small. The reaction of the cervical secretion is alkaline. In not a single case were there organisms in the cervix which liquefied gelatin. The external os is usually the boundary between that portion of the genital canal which contains micro-organisms and that portion which does not.

Kottmann,[1] with a special apparatus to prevent contamination, finds pathogenic micro-organisms in a considerable proportion of the pregnant women examined. Williams,[2] on the contrary, claims that the vagina is free from pathogenic germs.

Vahle[3] finds that for the first twenty-four hours the vaginal secretions of new-born infants are sterile. By the third day they always contain micro-organisms, and in a considerable pro-

[1] "Arch. f. Gyn.," Bd. lv. H. 3.
[2] "Am. Jour. of Obstet.," vol. xxxviii.
[3] "Zeitschr. f. Geb. u. Gyn.," Bd. xxxii, H. 3, v.

portion of cases the staphylococcus pyogenes albus and aureus and a streptococcus.

Stroganoff finds that within a few hours of birth the vagina becomes infected, and that in a certain proportion of cases the inoculation occurs *in utero*, or during the passage of the child's body through the vagina. This is most likely to occur in breech presentations. A great variety of micro-organisms may be found in the vagina of the newly born, including streptococci, diplococci, staphylococci, etc.

Stolz[1] finds streptococci, bacilli and cocci in the vagina. Natvig[2] finds streptococci in a state of diminished virulence on the vulva, which are easily carried or wander into the vagina and uterus, regaining their virulence in these situations. Procopio and De Angelis, investigating the presence of the colon bacillus in the vagina, found vaginal secretions sterile in 70 per cent. of the cases, cervical secretions sterile in 91.6 per cent.[3] Michni[4] finds trimethylamin in vaginal secretions and attributes to it decided bactericidal properties.

From this mass of facts, set down without any special order, confusing in its complexity and occasionally in its apparent contradictions, the practical physician may draw the following conclusions as to the etiology of puerperal sepsis: The vulva, like any other skin surface, such as the physician's hands, may be infected with pathogenic bacteria, and from its situation is most likely to be surgically unclean. Micro-organisms on the vulva may be diminished in virulence, but may become actively infectious if transplanted deep within the genital canal. The vagina becomes infected almost immediately after birth. In a normal condition it contains no pathogenic bacteria, but occasionally streptococci, staphylococci, and other pathogenic micro-organisms are resident in the vagina before labor. These germs, if present, are usually diminished in virulence, but may regain their full pathogenic power under conditions favorable to their growth and propagation. The vaginal canal has strong germicidal properties which serve to guard a woman against infection. They depend upon the presence of a special bacillus, and upon the products of its life-processes; upon the leukocytosis due to chemotactic action; upon phagocytosis; upon the germicidal powers, perhaps, of the anatomical elements of the vagina; of the cervical mucus, and of the bloody discharge during menstruation and the puerperium, and possibly upon the presence of trimethylamin.

[1] "Studien zur Bakteriologie des genitalkanales in der Schwangerschaft u. im Wochenbette," Graz, 1903; also Hegar's "Beiträge zur Geb. u. Gyn.," Bd. vii, H. 3.

[2] "Arch. f. Gyn.," Bd. lxxvi, H. 3.

[3] "Arch. di Ostet. e. Gin.," 1906, p. 385.

[4] "Jahresbericht," p. 94, vol. xvi.

During and after labor, mechanical safeguards of the most effective kind are furnished against infection. These are: the discharge of the liquor amnii, washing the vagina out; the passage of the child's body, scrubbing the vagina out; the descent of the placenta and membranes, and the bloody discharge which follows.

Moreover, should the vagina contain pathogenic bacteria, they are likely to be in a condition of diminished or absent virulence, in which they will not be productive of disease.

Bearing these facts in mind, it is apparent that the common practice of relying upon simple vaginal douching for disinfecting the vagina before labor, or before some gynecological manœuver or operation, is faulty, not to say foolish. It has been clearly demonstrated that the injection of an antiseptic fluid into the vagina does not destroy pathogenic germs there, and robs the woman, to a certain extent, of the safeguards that nature provides for her against infection. If, therefore, under certain circumstances, it is desirable to disinfect the vagina, mere douching should not be depended upon, but the vaginal mucous membrane should be thoroughly scrubbed out as well as douched, just as one would prepare the skin for an important surgical operation.

It is clear that these remarkable discoveries in regard to the micro-organisms normally present in the vagina do not, in the slightest degree, lessen the importance of antiseptic precautions on the part of medical or other attendants upon a patient in labor. The presence of the organisms in the vagina might possibly be used as an argument against the necessity for antiseptic precautions. For, it might be said, the vagina being already infected, it is unnecessary to observe such elaborate precautions against infecting it still more.

But when one considers that the micro-organisms in the lower genital canal are not pathogenic in the vast majority of cases, and that when they are their virulence is diminished or absent, it is obviously incumbent upon any conscientious man not to insert into the vagina infecting bacteria which may, by their number and virulence, overcome all the safeguards that nature provides, and may, consequently, be the cause of a serious and fatal disease.

The Pathogenic Microbes Capable of Producing Local Inflammation and General Systemic Infection when Introduced in the Genital Canal.—Streptococci were first observed in cases of puerperal infection by Mayerhofer in 1865 and were first cultivated from such cases by Pasteur in 1880.[1] Döderlein

[1] See the very instructive article, with full bibliography, by J. W. Williams, on "Puerperal Infection" in "The Practice of Obstetrics by American Authors," Jewett, 1899.

found the streptococcus pyogenes as the sole-infecting agent in five cases of serious puerperal infection.

Czerniewski, in 53 cases of puerperal infection, found streptococci in 49. In a histological and bacteriological examination of 16 cases of puerperal fever, Widal found streptococci in 14, bacilli in 2. Bumm, in an examination of 17 cases of puerperal infection, found streptococci in all—5 times as pure cultures, 12 times mingled with small numbers of staphylococci and of other germs. Thus, in a total of 91 cases, the streptococcus was found to be the infecting agent in 85, or 94 per cent.

Following streptococci, but a long way behind as the cause of puerperal infection, are the pyogenic staphylococci, the colon bacillus, the gonococcus, the tubercle bacillus, the bacillus pyocyaneus, the bacillus fœtidus, the pneumococcus, the Klebs-Löffler bacillus of diphtheria, the tetanus bacillus, and possibly any germ at all that, inserted into living tissues or deposited upon weakly resisting surfaces, is capable of causing local inflammation or general disease. In addition to specific septic micro-organisms, the anaërobic saprophytes of decomposition play an important rôle in the common form of puerperal sepsis, due to the absorption of toxins, or ptomains produced in the decomposition of dead animal matter, such as blood-clots, fragments of placenta, hypertrophied decidua, within the womb. Dobbin [1] has reported an interesting case of fatal puerperal infection, in which the bacillus aërogenes capsulatus (gas bacillus) was probably the infecting agent, or, at least, produced the toxins that fatally intoxicated the maternal organism, and, after death, developed the same emphysema in the maternal body which was found in the dead and macerated fetus at the time of delivery. This germ is accountable for cases of physometra, or tympanites uteri. It develops by preference in dead bodies, and may not manifest its presence during life. It finds in the dead fetus within the womb a habitat most suitable for its development; it gives rise to a horribly fetid inflammable gas, and probably to virulent toxins.[2]

Blumer [3] reports a case of mixed puerperal and typhoid infection in which the streptococcus and the typhoid bacillus were isolated both from the blood and the uterine cavity.

J. Whitridge Williams, of Baltimore, in an examination of forty patients, the cultures being taken from the ward cases

[1] "Puerperal Sepsis due to Infection with the Bacillus Aërogenes Capsulatus," "Johns Hopkins Hospital Bulletin," No. 71, February, 1897.

[2] See also studies of five cases by Lindenthal, "Beiträge zur Aetiologie des Tympania Uteri," "Monatschr. f. Geb. u. Gyn.," Bd. vi, p. 269.

[3] "Am. Jour. of Obstet.," Jan., 1899.

whenever the temperature went to or above 101° F. and from the out-door cases when it reached 102°, found—

Streptococci in	8 cases
Staphylococci in	2 cases
Colon bacilli in	6 cases
Strictly anaërobic bacteria in	4 cases
Unidentified aërobic bacteria in	5 cases
Bacteria were found in cover-glass examinations, all cultures being sterile, in	4 cases
Diphtheria bacilli in	1 case
Bacillus aërogenes capsulatus in	1 case
Typhoid bacilli in	1 case
Malarial plasmodia in blood, cultures sterile, in	1 case
No bacteria on cover-glass, cultures sterile and blood negative, in	11 cases

making a total of 44 cases, the difference between that number and the 40 cases actually examined being due to the fact that there were mixed infections in several instances.

The Manner in which Pathogenic Organisms Find an Entrance into the Genital Canal.—The majority of puerperal infections are traceable to the insertion of pathogenic germs by the examining finger or hand of the physician, who in the course of his daily work may have touched the dried sputum of diphtheria, the desquamated skin of scarlet fever, suppurating wounds, erysipelatous surfaces, and other virulent, infectious material; so that at any time his hands may fairly reek with the most dangerous poisons that could possibly be brought in contact with the parturient and puerperal woman. Many hundred cases have been traced directly to the association of the physician with infectious diseases, and there is scarcely a surer way of avoiding puerperal infection than by abstention from vaginal examinations. Epidemics of puerperal fever in hospitals have been quickly stamped out by avoiding all internal examinations, and the best morbidity and mortality records have been obtained in institutions in which vaginal examinations are eliminated as much as possible. Even if the examining hand is protected by a sterile glove, pathogenic bacteria may be carried into the vagina from the vulva, if there is a faulty technique in making the examination. The hands of the nurse or other attendants may be the agents that deposit bacteria in the vagina or upon the vulvar orifice. The implements used in and about the parturient canal, an atmosphere laden with dust or vitiated by foul unhygienic conditions, and the water used to wash and douche the patient may carry disease germs to the parturient woman and may introduce them into the genital canal. The bed-clothing, the personal clothing, the mattress, the vulvar pads, the material used to cleanse the vulva (rags, sponges, cotton, cloths), may each and all be sources of infection.

Putrescible material retained within the genital canal (especially within the uterine cavity) attracts the innumerable and ubiquitous saprophytes and their spores, with which the purest atmosphere swarms. The development of these bodies in a situation most favorable to their growth and active propagation may easily result in a toxemia, if not in actual invasion of the body by pathogenic germs.

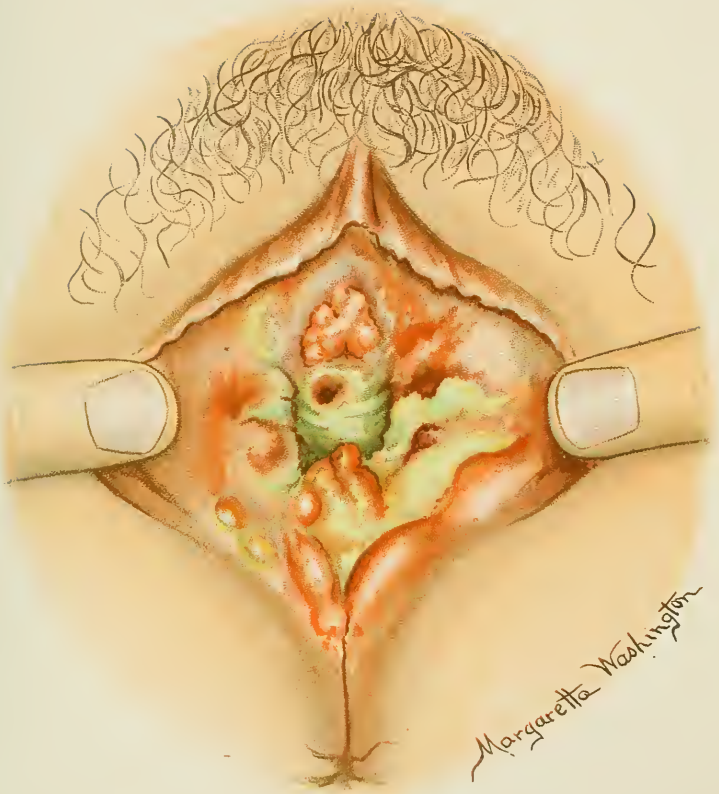
Coitus in the last weeks of pregnancy is said to be a source of infection of the genitalia in exceptional cases, by carrying pathogenic bacteria into the vagina. Finally, a certain proportion of cases may be traced to autoinfection—that is, to pathogenic germs resident in the body, and not introduced from without during or after labor. These germs may have had a lodgment in the vagina, as has been demonstrated in the bacteriological studies of that canal; or they may have been contained in a limited area near the genital canal, as in an old pyosalpinx, whence they spread by rupture of the pus-sac during labor, or in which they are incited to new activity by the compression and consequent reduction of vitality of surrounding tissue. There may have been tuberculosis of the genitalia, antedating conception. Or there may be, in the neighborhood of the uterus, tumors of low vitality and highly putrescible material, which, being reduced in resisting power by compression from the descending child, become infected by germs that ordinarily can not influence vigorous body-cells. Dermoid cysts and fibroid tumors are the best examples of these growths.

Even highly vitalized tissues like the pelvic muscles, especially the iliopsoas, may be so bruised and injured by the child's head that they slough and become gangrenous. The iliac bone, too, has become carious after the bruising to which it was subjected in a prolonged forceps operation.

The parturient woman may have had an infectious interstitial endometritis. The micro-organisms being lodged in the interstices of the mucosa, and the woman becoming pregnant, there is contained in the uterine cavity, even before conception, a cause of puerperal sepsis.

The Behavior of Pathogenic Micro-organisms when Introduced into the Genital Canal or Deposited upon its Entrance.[1] —The consequences of microbic invasion of the genital canal by pyogenic germs are variable in the extreme. If the bacteria enter wounds in or near the vaginal outlet, the result may be the same as in the infection of any wound in general surgery—that is to say, local inflammation, suppuration, and perhaps general systemic infection; but the infectious inflammation of a vaginal

[1] "Ueber die im weiblichen Genitalcanale vorkommenden Bakterien in ihrer Beziehung zur Endometritis," "Archiv f. Gyn.," Bd. 1, H. 3.



Streptococcic infection of the vagina and vulva, with pseudomembrane. Cured by local irrigation, general stimulation, and support (University Hospital).

wound is almost certain to spread upward, for the conditions are more favorable to microbic growth and to systemic invasion in the uterine cavity and in the tubal canals than in the lower portion of the genital tract. Hence it is that the vast majority of serious puerperal infections have their effective starting-point within the womb. For example, it has been found, in a streptococcic infection of the whole genital tract, that the micro-organisms were present in the vaginal mucous membrane alone, in the cervical mucous membrane, and in the tissues immediately subjacent; in the endometrium, and deep within the uterine muscle, showing that they could easily penetrate the deeper tissues within the womb, while they were incapable of invading the tissues underlying the vaginal mucous membrane. In other words, the resisting power of the tissues under the mucous membrane is less the higher the micro-organisms are found in the genital canal.[1]

Septic infection of the genital tract results often in the formation of false membranes. This is true of pure streptococcic infections, of mixed infections (streptococcus, bacillus fœtidus, bacillus pyocyaneus, the pyogenic staphylococci), and especially true, of course, of the rare cases of true diphtheria of the genital tract in which the Klebs-Löffler bacillus is found. The apparent false membrane in a septic endometritis is due to a necrosis of the endometrium, clothing the uterine walls with a dirty, greenish-yellow covering.

There is much yet to learn of the antagonisms and associations of pathogenic germs in puerperal infections. This much, however, may be asserted with confidence: the streptococcus is frequently associated with the pyogenic staphylococci, the bacillus fœtidus, the bacillus pyocyaneus, and the colon bacillus, though it is said to drive away or to destroy the staphylococci after a time.

The gonococcus seems often to prepare the way for the streptococcus, which, in its turn, may destroy the gonococcus, conquering the latter in a struggle for existence and remaining in sole possession of the field. The streptococcus appears often to prepare the way for the colon bacillus, which certainly wanders in frequently in the course of streptococcic infection.

Streptococci, staphylococci, and the pyogenic bacilli have preëminently the power to penetrate the tissues of the uterus and to distribute themselves throughout the body. This is particularly true of the streptococci.

Gonococci and the colon bacilli confine themselves most often to the endometrium and to the tubal mucosa. The former is the pathogenic agent in a large proportion of the cases of

[1] Lahn, "Inaug. Diss.," Jahresbericht, 1894.

septic endometritis after labor. The latter is often found in cases of physometra. Both of these organisms, however, can penetrate the uterine muscle, and may be distributed through the system by the lymph-channels or by the blood-vessels. Streptococci show a preference for the lymphatic channels in their invasion of the tissues. Hence they usually pass from the endometrium to the myometrium, to the parametrium, and to the subperitoneal lymphatics, perhaps affecting the tubes and ovaries, secondarily, perhaps causing abscesses or general infection of the peritoneal cavity, or of the pelvic connective tissue. The putrefactive micro-organisms (saprophytes) are anaërobic, and confine their activity mainly to the decomposition of putrescible uterine contents, particularly of hypertrophied endometrium, which is practically cut off from its blood-supply by the contraction of the womb, and is peculiarly liable to rapid decomposition. During the process of putrefaction the saprophytes manufacture soluble and absorbable products (toxins) of a highly pathogenic nature, causing possibly a fatal intoxication without actual microbic invasion of the body. Moreover, saprophytes occasionally attack blood-clots in the uterine sinuses, and may be swept into the general circulation by detachment of a thrombus and deposited as a septic embolus in different portions of the body, causing metastatic abscesses. It is claimed also that the bacteria of putrefaction and their toxins increase the virulence of streptococci.

Symptoms and Diagnosis of Puerperal Infection.—The symptoms of puerperal infection are local and general. The latter are : an elevated temperature, preceded perhaps by a chill ; a rapid pulse, and profound physical depression, with the development in some cases of metastatic inflammations of any of the organs or tissues in the body. The tongue is coated ; the breath is heavy. There is a disinclination to take food. There may be intense thirst ; nausea and vomiting are not uncommon, and a septic diarrhea appears in the worst cases. There may be blotches of a scarlatiniform eruption upon the skin.

The local symptoms of septic infection are : a foul discharge, redness of the mucous membrane, spots of ulceration and false membrane formation along the lower genital canal, edema of the vulva, and, possibly, pelvic peritonitis with an exudate. Or there may be other inflammatory affections of the generative organs, such as superficial catarrhal colpitis or ulcerative metritis, the symptoms of which are described in their appropriate places. It is not likely that any case of puerperal sepsis will present all the symptoms just detailed. Elevation of temperature and rapid pulse alone after labor should be regarded as indicative of puerperal infection if no other cause for them can be demonstrated.

It is possible, indeed, to see elevation of temperature alone as a symptom of puerperal infection in the early part of the puerperium, during which time the influences that normally reduce the pulse-rate are so active as to counteract the disposition to rapidity of pulse usually shown in septic infection. The slow pulse, however, does not continue long. At the end, usually, of thirty-six hours, rapid heart-action appears.

It may be difficult to make a differential diagnosis between septic fever and some of the other causes of elevated temperature after labor. In these cases it is wise to treat the patient for puerperal sepsis by a thorough disinfection of the parturient tract, while at the same time the bowels are well evacuated and a full dose of quinin is administered to dispose of a possible intestinal toxemia, and to combat a possible malarial infection which in many parts of the country, especially in the spring and fall, is a not improbable event.

A microscopic examination of the blood is always advisable in a doubtful case, to discover the leukocytosis of sepsis or the protozoa of malaria.

Typhoid fever may be most difficult to distinguish from puerperal infection. The difficulty is increased in some cases by the fact that a Widal reaction may occasionally be obtained in streptococcic infection and that there may be a mixed infection by the bacillus typhosus and streptococci. Blood-cultures have enabled me to make a diagnosis of typhoid fever in several cases referred to the Maternity with the idea that they were streptococcic infections.

The appearance and number of the blood-corpuscles is of interest in all cases of sepsis and may have distinct diagnostic value. Leukocytosis should be marked at first, unless the system is overwhelmed with septic intoxication. The absence of leukocytosis, therefore, in a grave case is unfavorable. An exacerbation of the leukocytosis usually indicates a fresh focus of infection, an extension of the process, suppuration, or the development of new generations of micro-organisms. A subsidence of the leukocytosis indicates a spontaneous cure or a localization of the process. If the septic process is strictly limited, there may be no overplus of leukocytes at all. In a large abscess in the paravesical connective tissue between the uterus and bladder four weeks after labor there was less than the normal number of white blood-corpuscles. It should be remembered that leukocytosis does not necessarily mean suppuration. It may be absent in cases of abscess; it may be most marked in streptococcic infection of the lymph-channels without suppuration. In addition to the leukocytosis, the blood in the puerperal sepsis shows degenerative changes in all its corpuscular elements.

The differential count of the leukocytes is helpful. A high percentage of polymorphonuclear cells is usually indicative of suppuration.

Any elevation of temperature after delivery calls for the most careful investigation. A *vaginal examination* should be made, both digitally and with the speculum, to detect the following conditions: Redness of the mucous membrane and edema of the vulva; false membranes and ulceration in the vagina; arrested involution and fixation of the uterus; bogginess and extreme

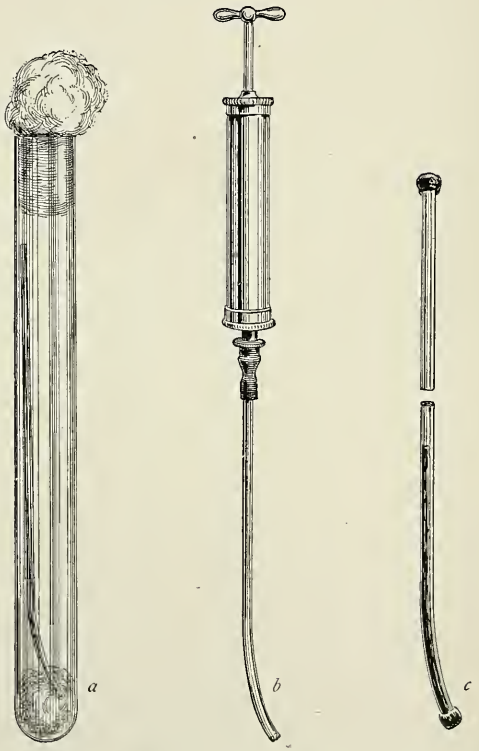


Fig. 551.—Döderlein's lochial tube: *a*, Lochial tube within its test-tube; *b*, tube with syringe attached; *c*, tube sealed, for transportation to laboratory. The cervix is exposed by a Sims speculum, is pulled down by a tenaculum, and wiped off with bichlorid solution on pledgets of cotton. The implements and operator's hands must be aseptic.

tenderness of the uterine walls; enlargement of the tubes; enlargement, fixation, or displacement of the ovaries; edema or exudate in the pelvic connective tissue, and thromboses in the

pelvic veins. The abdomen should be carefully palpated for tenderness and exudate; the character and odor of the lochia must be observed. A leukocyte and a differential count should be made. The blood should be examined for the Widal reaction and for the protozoa of malaria. There are two methods of precision in the diagnosis of puerperal sepsis which ought always to be employed if possible in doubtful cases: intra-uterine and blood cultures. The first is based on the assumption that the uterine cavity is sterile in the normal case; if pathogenic bacteria are discovered in the lochia withdrawn by Döderlein's tube or one of its modifications, the patient is infected; if the cultures from the uterine cavity

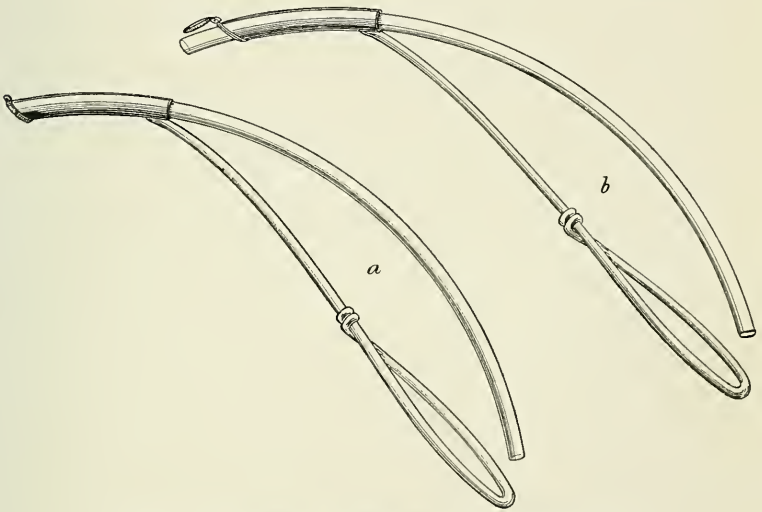


Fig. 552.—Nicholson's modification of the Döderlein tube.

are sterile, it is assumed that the patient is not infected, though she has fever and other symptoms usually due to sepsis. Unfortunately this method is not invariably reliable. From 30 to 80 per cent. of afebrile cases show a positive result from intra-uterine cultures, the percentage increasing as the puerperium advances,[1] and in a series of 9 cases of streptococcic infection in the University Maternity there was a negative result in 4 cases by cultures from the uterine lochia. The more careful the technique, to avoid contamination of the lochia, the more accurate is the diagnosis by this method, but with the very best technique it may be inaccurate and cannot

[1] Brownlee, "The Germ Content of the Uterus and Vagina during the Normal Puerperium," "Journal of Obstet. and Gyn. of the Br. Empire," September, 1905; Little, "The Bacteriology of the Puerperal Uterus," "Am. Journ. of Obstet.," Dec., 1905.

be depended upon. Cultures from the blood-serum are more reliable. In a series of 35 cases in the University Maternity this method did not fail us once as a means of precision in diagnosis.[1]

Although the attempt to study the bacteriology of the blood in cases of infection was begun many years ago it is only in the last three or four years that the method has become satisfactory as a means of precision in diagnosis. At first a drop of blood was taken from the ear and smears made upon solid culture media. Recently the bactericidal property of the blood has been recognized; it is now realized that considerable quantities of blood serum must be procured, that it must be well diluted in the culture media and that the technique of the investigation must be as perfect as possible to obtain satisfactory results. Dr. J. S. Evans, of the Pepper Laboratory of the University of Pennsylvania, employs the following method: A glass Luer syringe with a platino-iridium needle, holding 10 c.c., is wrapped in raw cotton, enclosed in filter paper, sealed, and is sterilized by hot air at a temperature of 150° Cent. for one hour. The patient's arm is prepared as for an operation above and below the flexure of the elbow; is washed with tincture of green soap, hot water, and pledgets of sterile cotton; then with alcohol; a wet bichloride of mercury dressing is applied for ten minutes; the skin is then washed off with sterile water and a dry sterile dressing applied until the time for withdrawal of the blood. The operator wears sterile rubber gloves. Pressure is applied above the elbow. The platino-iridium needle attached to the syringe is flamed, and plunged into the most prominent vein. Ten c.c. of blood are withdrawn. The needle is detached from the syringe to lessen the risk of contamination. 1 c.c. of blood is injected from the syringe into five flasks of bouillon, each containing 150 c c. The flasks are thoroughly agitated. Three c.c. of blood are distributed among 6 tubes of litmus milk. The remaining 2 c.c. of blood are discarded, as it is the first quantity withdrawn and the most likely to be contaminated. The litmus milk tubes are for anaerobic cultures which are made by the pyrogallic acid and the sodium dioxide method. All the flasks are incubated at 37.5° C. At the end of twenty-four hours, the flasks are examined and sub-cultures are made on slanted agar and glycerine agar. At the end of the next twenty-four hours, if the cultures are positive, growth has occurred on the so id media. If no growth has occurred, the flasks are kept at incubator temperature for a week and sub-cultures are made daily. In taking the uterine lochia for cultures the implements (a Sims' speculum, a single tenaculum, dressing forceps, cotton, and Nicholson's tube) must be sterile. The vulva must be cleansed, the operator must wear sterile rubber gloves, and the cervix must be exposed so that the tube may be inserted without risk of contamination. After inserting the protecting metal sheath, the glass tube within it is pushed further into the uterine cavity, opening the metal shutter on the end of the former. The lochia is drawn into the glass tube by suction. The glass tube is then withdrawn into the metal sheath; the two together are then withdrawn and both ends of the glass tube are sealed by heat. The sealed tube is sent to the bacteriological laboratory for investigation.

Unfortunately, both these methods demand the skill and training of an expert. Any imperfection of technique vitiates the results and makes the examination worse than useless, as it may lead to serious errors in diagnosis.

Preventive Treatment of Puerperal Sepsis.—It is convenient to deal separately with the several sources of puerperal infection in describing the preventive treatment.

Atmosphere.—While the air is not so frequent a source of infection as it was thought to be in the beginning of the anti-

[1] B. C. Hirst, "Some Problems in the Diagnosis and Treatment of Puerperal Infection," "Am. Medicine," Jan. 27, 1906; W. R. Nicholson and J. T. Evans, "The Bacteriology of the Puerperal Uterus," "Am. Jour. Med. Sci.," August, 1908.

septic era, it is undeniable that an atmosphere which is stagnant, deprived of sunlight, impregnated with dust, tainted with foul odors and mephitic gases, may not only contain disease germs and spores in larger proportion than it should, but also has a most depressing effect upon an individual subjected to its influences, reducing the vitality and resisting power of the body cells until there occurs, perhaps, microbic invasion of the system that would have been successfully resisted had the organism preserved its normal combative power against pathogenic bacteria. The lying-in room, therefore, should be sunny; should be well ventilated—best by an open fire-place; and it should not possess a stationary wash-stand or any other connection with the sewer; nor should it be too near the bath-room and water-closet. If there is a stationary wash-stand in the room, its outlet should be kept stopped, water should be allowed to stand in it, and the overflow holes should be plugged with small corks or putty. If the bath-room immediately adjoins the lying-in room, the door between should be stripped.

If the room is heated by a hot-air furnace, the intake for the air and the sanitary condition of the cellar may need investigation. The nurse should be cautioned not to leave trays of food, an unemptied bed-pan, or a commode in the room over night or for any length of time. An antiseptic vulvar pad should be worn during the continuance of the lochial discharge, so as to protect the genital orifice from contact with the atmosphere, and the materials of which this pad is composed, or, rather, the antiseptics with which it is impregnated, should be chosen with a view of keeping the bloody discharge from decomposing, should it soak through the pad, and thus be exposed to atmospheric contamination. The best materials for this purpose, in my experience, are salicylated cotton and carbolized gauze.

Water.—The water used for douches, if they are employed, or for washing the vulva and perineum, may be the source of fatal infection. All the water used about the puerpera should be boiled beforehand for at least half an hour. It is not sufficient to make a germicidal solution—as, for example, of corrosive sublimate—in the belief that all germs in the water are killed by the antiseptic employed. Tetanus bacilli will live for hours in a 1 : 4000 bichlorid of mercury solution, and the other antiseptics usually employed in obstetric practice—lysol, kresin, creolin—may be perfectly inert against many dangerous pathogenic germs during the time that usually intervenes between the preparation of antiseptic solution and its use upon a patient. Three women in the University Maternity contracted tetanus from intra-uterine douches of unboiled water (creolin, two per cent.), during a time

when the water of Philadelphia was unusually turbid, in consequence of freshets in the Schuylkill Valley.

It is possible that the patient's vagina might be infected in the full bath taken before labor begins if she sits or lies in the tub full of water which may be contaminated by the rinsings from her body. A sponge or douche bath in the erect posture is safest.

The Patient.—The parturient and puerperal woman may be infected by disease germs carried upon her person, especially in the pubic and anal regions; by her personal clothing, by the bed-clothing and mattress, by the vulvar pads and the pads upon which the buttocks rest, by the material used to wash the vulva and perineum, and by pathogenic bacteria lodged in the vaginal or uterine mucous membranes before labor or even prior to conception.

To insure the greatest obtainable degree of personal cleanliness, the woman falling in labor should be given a full bath, special attention being paid to scrubbing the genital region most thoroughly with soap, hot water, and a soft, bristle brush or a wash-rag. In hospital practice my patients are shaved. In private practice this is also done if the patient permits it. Sometimes a depilatory is allowed if shaving is not permitted. After the bath, the woman should put on clean clothes throughout. The mattress on her bed should not be soiled by the discharges of previous labors, by urine, feces, or other putrescible matter. It should not have been used in any case of contagious or infectious disease, and it should be protected by a rubber cloth that has been carefully scrubbed clean. The bed-clothing should be clean, the bed being freshly made up for the labor. The pads on which the buttocks rest during labor and afterward should be made of nursery cloth prepared in the way described in the directions to the nurse (boiled and dried). It is scarcely necessary to say that a pad when soiled should be thrown away and not used again. The vulvar pads should be made of carbolized gauze and salicylated cotton—the best materials for disinfecting a bloody discharge. The nurse should make them up with sterile hands as they are required, or if she makes a number at a time they should be wrapped in a clean towel and taken out for use with sterile hands. The material used to wipe off the genital orifice, the mouth of the urethra, and the perineum should be absorbent cotton sterilized by heat or by soaking in a 1:1000 solution of sublimate for at least one-half hour before use. During the second stage of labor these pledgets of cotton are employed to wipe away feces as it emerges from the anus, always in the direction from before backward.

Care must be exercised to remove blood and blood-clots

from the vulva before putrefaction sets in. This is best done by placing the woman on a bed-pan, letting a stream of boiled water run over the parts, and, if necessary, using cotton to wipe them off. This should be done about six times in the twenty-four hours for the first four or five days.

A careful examination should be made of every woman's vaginal discharges in the beginning of labor. If there is leukorrhea, or any pathological condition of the vaginal secretions, the vagina should be thoroughly scrubbed with tincture of green soap, hot water, and pledgets of cotton, and should then be douched with a bichlorid of mercury solution, 1 : 2000, a little clear water being employed at the end of the douche to wash out any residual sublimate solution that might poison the patient or do harm to the infant's eyes in its descent through the birth-canal.

It should be borne in mind, in the conduct of the labor, that excessive bruising, long-continued pressure of the maternal tissues, and extensive injuries, all conduce to microbic invasion of the parts by reducing their vitality and by affording, through solutions of continuity, a ready entrance into the system. The proper conduct of labor, therefore, is an extremely important item in the preventive treatment of puerperal sepsis.

Finally, in the management of the third stage of labor and of the early puerperium, the greatest care should be exercised to evacuate the uterine cavity of all putrescible matter and to secure, as far as possible, firm contraction of the womb, for the presence of putrescible material within the uterine cavity attracts saprophytes, and an imperfect involution of the womb favors the direct invasion of the uterine sinuses and blood-channels by microorganisms and the absorption of the products of microbic activity into the circulation and into the lymph-spaces.

The Physician.—The physician should not carry infectious germs upon his person or clothing into the lying-in chamber, and he should be scrupulously careful not to insert pathogenic germs into the woman's vagina in the course of his examinations. If a general practitioner is in attendance upon infectious and contagious diseases, he should either give up obstetric practice entirely, or, if he can not do so, he should take a full bath and should change his clothing completely before attending a woman in labor.

A long linen gown or duck trousers and a cheviot shirt should be carried in the obstetric bag. The change of clothing should be made in another room before seeing the patient at all, or, at any rate, before making an examination.

The methods of hand cleansing are described in the section on Aseptic Technique. The routine use of sterile rubber gloves

in addition to the hand disinfection is an indispensable precaution. If version or any manœuver is attempted involving the deep insertion of the hand into the uterine cavity, the long gauntlet glove, reaching to the elbow, should always be worn. The examining finger should be anointed with carbolized vaselin (5 per cent.) or the sterile unguent provided in collapsible tubes, and in making the examination the vulvar orifice should be exposed by raising the upper buttock as the woman lies upon her side, so that the finger may be inserted directly into the vagina without becoming contaminated by being swept over the skin near the anus or pubes while searching for the vulvar orifice. Before inserting the finger, the skin around the vaginal entrance should be wiped off with a pledget of cotton soaked in a 1:2000 sublimate solution. As every examination entails some risk of infection, they should be as limited in number as possible. The best results in morbidity and mortality have been secured by an almost entire elimination of the vaginal examination, which has been replaced, in the practice of some enthusiasts, by abdominal palpation, and even by rectal examinations. It is unnecessary, however, and is, moreover, inadvisable to give up the vaginal examination altogether. Much may be learned by abdominal palpation, so that there is little necessary information to be gained by examining *per vaginam*, but there are some conditions that can be learned in no other way. A few vaginal examinations in the course of labor are therefore indispensable. No harm is done if their number is restricted, if the examining hand is protected by a sterile glove, and if the examination is conducted in the way just described.

The Nurse.—The nurse should adopt the same precautions in regard to personal cleanliness that have been recommended for the physician. She should not have come from a contagious or infectious case. She should put on fresh clothing throughout for attendance upon the obstetrical patient. She must take a full bath, scrubbing her hair and scalp well with soap and water, and rinsing her hair in a 1 : 1000 sublimate solution. She should cleanse her hands and put on sterile rubber gloves before attempting any manipulation of a patient's genital region or of her breasts. It is her duty also, in the care of a puerpera, to enforce the sanitary and aseptic regulations already described under their appropriate heads.

The Implements.—All implements to be used about the person of the parturient and puerperal woman should be boiled for at least five minutes. A 1 : 1000 sublimate solution should be employed for the disinfection of the few articles that might be injured by boiling water, a full half hour at least being

allowed for the immersion, and the bichlorid solution being made up with boiled water.

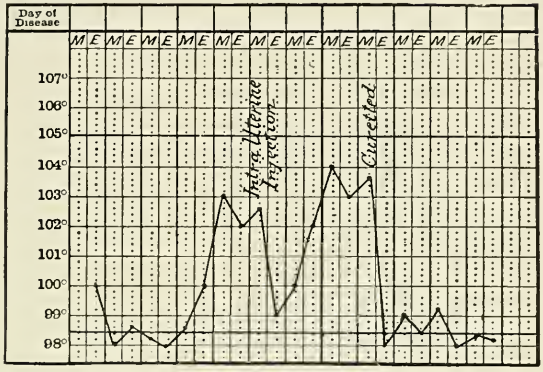


Fig. 553.—Temperature-chart of a case treated in vain by intra-uterine irrigation, but cured immediately by the instrumental evacuation of the uterus.

The Curative Treatment of Puerperal Infection.—The treatment of puerperal sepsis is both local and general. Locally, a thorough disinfection of the whole genital canal is called for in every case of puerperal infection. It may appear unnecessary, and may prove, on actual experience, to be even harmful, but no one can tell beforehand how necessary this procedure is. In the vast majority of cases it is productive of the greatest good. It is only occasionally useless, and very rarely actually harmful. It should, as already stated, precede all other treatment for puerperal infection. The method of disinfecting the genital canal may be described as follows: A double tenaculum, a large, dull curet, a placental forceps (Emmet's curetment forceps is the best), and an intra-uterine catheter are boiled for fifteen minutes. The operator disinfects his hands and arms and wears sterile gloves. The patient is placed in the dorsal posture across the bed, with her buttocks resting on a rubber pad. The external genitalia and the vagina are scrubbed with tincture of green soap and pledgets of cotton; the vagina is douched with a sublimate solution, 1:2000. The operator then seizes the anterior lip of the cervix with the tenaculum. An intra-uterine douche of sterile water, at least a quart, is administered. Then, with the placental forceps, and, if necessary, with a dull curet, the uterine walls are gone over thoroughly but lightly in all directions, six to twelve times, until nothing is brought away but bright blood. A second intra-uterine douche concludes the treatment. If the womb is flabby and large, with a tendency to flexion, so that the drainage of the

uterine cavity is not good, it is advisable to pack it with iodoform or sterile gauze.

Much discredit has attached to this method of instrumental evacuation of an infected uterus because it has too frequently been carried out like a curettage of a non-puerperal uterus, which would often result in implanting infection in the myometrium or in perforating the uterus.

In addition to cleansing the uterine cavity in the manner described, the operator should take the opportunity of carefully inspecting the visible portion of the parturient tract; and if there are false membranes or areas of inflammation and localized infection on the cervix or in the vagina, they should be carefully treated—best by the application of a strong solution of nitrate of silver, a dram to the ounce.

It may be necessary to repeat the intra-uterine douches several times—in fact, several times a day for many days; in this case plain sterile water only should be used. Nothing is gained by the employment of strong sublimate solutions, which can not always reach and destroy the infecting micro-organisms of the genital tract, but which do have a most depressing action upon the body-cells of the walls of that tract, reducing their resisting power against the invasion of attacking bacteria, and which may fatally poison the patient. The author has employed a one per cent. formalin solution in glycerin and water, tincture of iodin, 1 dr. to a pint each of water and alcohol, and a five per cent. argyrol solution as intra-uterine douches with better results than are obtained by sublimate solutions.

It is rarely necessary to repeat the instrumental evacuation of the uterus. It may be advisable to provide drainage from the uterine cavity by the insertion of a strip of gauze to the fundus. This is only necessary, however, in cases of flabby, relaxed wombs which are so sharply anteflexed as to prevent the free exit of the lochial discharge.

The general treatment is stimulating. The patient should have as much food of an easily digestible character, chiefly milk, as she can assimilate, and as much alcohol as she can consume without showing the physiological effects of it. Digitalis is useful as long as the pulse is above 110. Strychnin may be combined with it in suitable cases. To tide the patient over emergencies, carbonate of ammonia in large doses, by the bowel, and nitroglycerin hypodermatically, may be required. Inhalations of oxygen may also be of service. Absolute rest and freedom from all disturbances, mental and physical, must be insisted upon, and the patient should be given the best nursing that the family can afford.

The Serum-therapy of Puerperal Sepsis.—Stimulated by the success of this treatment in diphtheria and in other infectious diseases, an effort has been made to procure a serum that is antagonistic to streptococci and antidotal to the products of their activity.

A committee appointed by the American Gynecological Society[1] reported in May, 1899, that 352 cases had been treated by anti-streptococcic serum, with a mortality of 20.74 per cent. After a personal trial of the method extending over three years I discarded it, but have lately resumed its use, as it undeniably is followed occasionally by decided and sometimes by brilliant results. From 20 to 80 c.c. are injected once to four times a day. Further studies of the anti-streptococcic serum, as to its bacteriolytic power, agglutinating activity and as a stimulating agent for the production of opsonins, with improvements in its production suggested by this investigation, promise a remedy in the future of great use.

The Bacterin Treatment of Septic Infection.—As a result of the discoveries of Wright and others of the increased opsonic index produced by the injection of dead and sterilized micro-organisms of the kind which caused the infection, the injection of streptococcic, staphylococcic, gonococcic, and tubercular bacterins is securing a trial in puerperal infections. In one of my cases of severe and long-continued streptococcic infection which had resisted all other treatment, an injection of two and a half million streptococci was followed immediately by a permanent disappearance of all symptoms.[2]

The Treatment of Septic Infection by the Artificial Production of a Hyperleukocytosis.—Phagocytosis has been demonstrated to be particularly effective in destroying streptococci, if the blood serum is rich in opsonins, the mere overplus of leukocytes not being sufficient unless the bacteria are opsonated. It is logical therefore to stimulate the production of leukocytes if at the same time measures are taken to increase the opsonins of the blood. Antistreptococcic serum does the latter to some extent, it is claimed.[3] So do the bacterins. Several agents have leukocytic powers, notably pilocarpin, albumose, and nuclein. The last is the best remedy in septic infection. Ten to sixty minims of nuclein solution should be given hypodermically three times a day.

Hofbauer,[4] from Schauta's clinic in Vienna, reported the results of employing Horbaczewski's nuclein in seven cases of puerperal

[1] "Am. Jour. of Obstet.," vol. xl, No. 3, 1899.

[2] "The Opsonic Treatment of Disease," Illman and Duncan, "N. Y. Med. Journ.," June 27, 1908.

[3] "Phagocytosis and Opsonins," Ludvig Hektoen, "Jour. Am. Med. Assoc.," May 12, 1906.

[4] "Centralbl. f. Gyn.," No. 17, 1896, p. 441.

infection, and in a later report adds twelve more to the list.[1] The cures effected in some of these cases certainly warrant a further trial of the method. For some years I have administered nuclein routinely as a part of the treatment of puerperal sepsis.

A peculiar method of increasing the polynuclear cells has been proposed in France: horse serum is heated every two hours for three days to 56° C. Some of the serum is dried by evaporation. The uterine cavity, previously cleansed and dried, is tamponed with gauze saturated with the serum and containing besides 1–3 gr. of the dried serum. The tampon is changed in twenty hours.[2]

The Treatment of Sepsis by Washing the Blood; Hypodermatoclysis; Intravenous Injections of Saline Solutions,[3] is a modern treatment attended with decided success. The best fluid for the purpose is 1½ gr. CaCl, 11½ gr. KCl, to 34 oz. normal salt solution.[4] Injections of large amounts—more than two quarts—of this fluid into the bowel seem to give as good results as hypodermatoclysis, and are much more convenient. The use of the modified normal salt solution is a valuable adjuvant to the other measures required in the treatment of puerperal sepsis.

Colloidal Silver (protargol, collargol, argyrol)—by inunction (Credé's ointment), by intravenous injections (3–5 cm. 2 per cent. solution of collargol repeated three to four times), by rectal injections—has its advocates. It has secured extensive clinical trials in Chrobak's Clinic, in the Charité in Berlin, in Buda-Pesth, and in other large maternities. The verdict, on the whole, is favorable. As an adjunct to other treatment it may be recommended.[5]

The Operative Treatment of Sepsis in the Child-bearing Period.—Since the first performance by Tait of abdominal section for purulent peritonitis there has been an extremely important development, in the scope of pelvic and abdominal surgery for septic inflammations during the child-bearing period.

Regarded at first as a procedure analogous to opening an abscess anywhere on the body, the whole abdominal cavity being looked upon as an abscess-cavity and the abdominal walls as its capsule, abdominal section for puerperal sepsis has become a generic term of wide significance, including hysterectomy, salpingo-oöphorectomy, evacuation of abscesses in the peritoneal cavity and in the pelvic connective tissue, removal of gangrenous

[1] "Arch. f Gyn.," Bd. lxvii, H. 2.

[2] "Bull. Soc. d'Obstet. de Paris," Tome ix, 1906.

[3] Bose, "Presse médicale," No. 49, 1896.

[4] See experiments of W. H. Howell, in Boston, on frog's heart; modified Ringer fluid. "The Use of Intravenous Saline Injections for the Purpose of Washing the Blood," H. A. Hare, "Therapeutic Gazette," April 15, 1897. The technic of the injection is the same as for the injections required in the treatment of the acute anemia following severe hemorrhage.

[5] "Wien. Klin. Wochenschr.," No. 10, 1906; "Med. Klinick," p. 816, Nos. 31–34, 1906.

or infected neoplasms of or in the neighborhood of the parturient tract, and exploratory incisions.

Indications for Abdominal Section in the Treatment of Puerperal Sepsis.—It is more convenient to deal generically with the indications for abdominal section in the course of puerperal sepsis, for the operation is usually decided upon in practice without reference to what may be required after the abdomen is opened, the surgeon holding himself in readiness to perform any of the pelvic or abdominal operations detailed above that may be found necessary when the abdominal cavity is exposed to view and to touch.

In order to decide correctly for or against celiotomy in the course of puerperal septic fever, the medical attendant must be familiar with the different forms of sepsis after labor, and should know which of them are most and which are least amenable to surgical treatment. In a general way, it may be stated that the operation is demanded most frequently for localized suppurative peritonitis; it may be indicated, and often is, for diffuse suppurative peritonitis; for suppurative salpingitis and ovaritis; for suppurative metritis, if the inflammation extends outward toward the peritoneal investment of the womb or into the connective tissue of the broad ligament; for abscesses in the pelvic connective tissue; for infected abdominal or pelvic tumors. On the contrary, abdominal section is contraindicated or is not required in simple sapremia; in septic endometritis of all forms—diphtheric,[1] ulcerative, suppurative; in dissecting metritis, sloughing intra-uterine myomata, which can be removed by enucleation or avulsion, or in suppurative metritis with the abscess pointing into the uterine cavity; in phlebitis, lymphangitis, and in direct infection of the blood-current. One is most likely to perform an unnecessary operation in streptococcic endometritis. By the time that symptoms justify surgical intervention in this condition it is almost always too late.

It is difficult to formulate rules in a situation involving so much responsibility, and of necessity so dependent upon many circumstances, as that seeming to require a very serious surgical operation in the midst of an adynamic fever with, very likely, profound depression, rapid pulse, high temperature—in short, with everything a surgeon least desires in the face of a major operation.

The operative treatment of puerperal sepsis should be avoided if possible, and is not indicated by the cardinal symptoms of septic infection—high temperature, rapid pulse, and general depression.

[1] By diphtheric endometritis is meant a dirty, grayish- or greenish-brown exudate on the endometrium, containing mixed micro-organisms, and not necessarily the Klebs-Löffler bacillus. For a report of one and the mention of four cases of true diphtheria of the genitalia see Williams, "Amer. Jour. of Obstet.," August, 1898.

There should be some demonstrable evidence of intrapelvic or abdominal inflammation, necrosis, or suppuration.

On the first appearance of symptoms that justify the diagnosis of diffuse suppurative peritonitis, the abdomen must be opened without more delay than is necessary for an aseptic operation. Even with the utmost promptness the operation is almost always too late, for the inflammation extends so rapidly and at first insidiously that by the time a diagnosis is possible the progress of the disease can not be stayed. It must be admitted, however, that an occasional success is possible by timely surgical interference.[1]

Again, in the presence of exudate, adhesions, or unnatural enlargement of any pelvic structure, suppuration may be suspected if the physical signs do not improve and if the temperature, pulse, and general condition indicate a continuance of septic inflammation. It is hardly necessary to state that if pus forms it must be reached and evacuated irrespective of its situation. Just how long to wait, however, is a question requiring experience, good judgment, and a special study of each individual case for its correct answer.

Enormous pelvic and abdominal exudates may disappear; adhesions may melt away; enlarged and inflamed tubes, ovaries, and uterus may resume their proper size, functions, and condition on the subsidence of the inflammation; but in these favorable cases distinct signs of improvement manifest themselves in a few days, and the course of the disease is comparatively short. A mere protraction of septic symptoms is in itself suspicious, *along with local signs of inflammation.* Without the latter, the same general symptoms, sometimes lasting for months, indicate phlebitis and infection of the blood-current. In this form of sepsis an operation, I believe, can do no good and may do the greatest harm.

In infected tumors in and near the genital tract the indication for operation should be plain and the decision easy. The presence of the tumor should, of course, be known. On the first sign of inflammation in it, or in the event of an elevated temperature for which there is no good explanation, the tumor should be removed. Early operations in these cases have furnished the best results, delayed operations the reverse.[2] In cystic tumors the likelihood of twisted pedicle should be remembered, and in every case of child-birth complicated by a new growth the woman

[1] Hirst, "A Diffuse, Unlimited, Suppurative Peritonitis in a Child-bearing Woman Cured by Abdominal Section," "Medical News," 1894.

[2] The most desperate cases, however, need not be despaired of. I have successfully removed a gangrenous ovarian cyst from a puerpera who was so weak that complete anesthesia was not attempted. The late Dr. Goodell had declined the operation as necessarily fatal.

should be watched with extraordinary care to detect the first indication of trouble.

An exploratory abdominal incision should be made, as a rule, only when it is desired to determine if a pelvic mass, presumably containing pus, is situated within or without the peritoneal cavity, and if the abscess had better be evacuated through the abdominal cavity or extraperitoneally. In the early period of experimentation with abdominal section for puerperal sepsis exploratory incisions were made in obscure cases without local symptoms of inflammation in the pelvis or the abdomen. None of these operations yielded information of value, nor did they benefit the patients. Consequently, it is a safe rule not to open the abdomen of a puerpera for sepsis unless there are physical signs of inflammation in the abdomen or the pelvis.

The proposition of Bumm, v. Bardeleben,[1] and others, to ligate or exsect the ovarian veins in thrombophlebitis, does not seem reasonable.

Thrombophlebitis is a conservative action to limit the spread of infection; if it is successful, the patient recovers, and this is the usual result. If the thrombus breaks down and there is septic metastasis (pyemia), the patient will probably die, even if the original site of the thrombus is removed. If the thrombus extends to the vena cava, the case is also hopeless. Another difficulty is the diagnosis. I know of no way by which a thrombus of the ovarian or hypogastric veins can be certainly diagnosticated before the abdomen is opened.[2] If abdominal section is done because thrombophlebitis is suspected, many an unnecessary operation will be performed. If the diagnosis is only made after the abdomen is opened for some other indication, there will not often be an excuse for ligating or excising the ovarian veins. I have had as ample an opportunity to inspect the pelvic and abdominal cavities in cases of puerperal infection as any of my colleagues in this country, and yet I have very rarely indeed seen a condition of the ovarian veins that called for their ligation or removal. Occasionally in the excision of necrotic tumors, infected appendages or uterus, it is obviously advisable to place the ligature beyond a thrombus in the vein, but thrombophlebitis as the sole indication of an operation and as the only thing to be removed is not yet demonstrated to the satisfaction of the majority of surgeons.

Following these general statements in regard to abdominal

[1] "Berliner Klin. Wochenschr.," 1908, p. 6.

[2] "Mahler's sign," a steady increase in pulse-rate without corresponding elevation of temperature (*Kletter puls*); pain in the loins; tympany; palpation of the thrombi may indicate thrombosis of the pelvic veins, but none of these signs is to be depended upon absolutely.

section for puerperal sepsis, it is now more convenient to describe in detail the different kinds of operations required for the various forms of intra-abdominal septic inflammations.

Abdominal Section for Intraperitoneal Abscesses and Diffuse Suppurative Peritonitis.—The situation and extent of localized suppuration within the abdominal cavity vary greatly. A quarter of the abdominal cavity may be filled with pus, the huge abscess-cavity being thoroughly walled off by dense exudate from the rest of the abdominal cavity. A smaller accumulation of pus about the orifice of the tube is not uncommon. Occasionally two or three abscesses the size of an orange are found between coils of intestine quite far removed from one another, and without apparent connection with the genital tract. Abscesses are found also between the fundus uteri and adjoining structures—the abdominal wall near the umbilicus, the caput coli, and the sigmoid flexure. In these cases infection travels through a sharply-defined area of uterine wall and appears in the same limits on its peritoneal investment. Exudate and adhesions immediately wall off the infected area, with the result of an encapsulated abscess between the uterine wall and the structure nearest to it at the time of inflammation. The treatment of these abscesses is evacuation, cleansing, and drainage. The cleansing may be effected by flushing with hot sterilized water, if the rest of the abdominal cavity can be guarded from contamination. It is usually best to avoid irrigation and in its place to thoroughly dry the cavities with gauze. For drainage, as a rule, sterile gauze with a glass or rubber tube is best. In certain cases of abscesses near the abdominal walls a rubber tube answers better than the gauze, and in deep-seated abscesses on the base and the back of the broad ligaments vaginal drainage by means of gauze or rubber tube is preferable. If the work during the operation is well done, there may be little or no subsequent discharge, and douching of the abscess-cavities during convalescence is uncalled for. Occasionally, however, if the abscess-cavity is large and well isolated, daily douching with sterile hot water is an advantage. In diffuse suppurative peritonitis the remote chance of success depends greatly upon the earliest possible operation, though there are many virulent cases in which nothing could check the spread of the inflammation and the deadly effect of septic intoxication.

This is not the place to discuss the symptoms of diffuse suppurative peritonitis, but one fact should be insisted upon from the operator's point of view. It is usually supposed that true diffuse suppurative peritonitis appears early after delivery; it may, however, develop at any time—as late as four weeks after

confinement. The technic of the operation is simple: A small incision is made, and the finger is rapidly swept about the pelvis and abdomen to determine the condition of the organs; then the irrigating tube is passed into the cavity at the lowest angle of the wound, and is swept about in all directions, while the return-flow is provided for by two fingers of the left hand distending the sides of the wound, which by the fingers and the irrigating tube is kept gaping as though by a trivalve speculum. The irrigating tube is pressed far over first on one flank and then upon the other, and the tip is cut down upon where it projects through the abdominal wall. Gauze and glass-tube drainage into the pouch of Douglas, a gauze drain in the flanks is provided for, and the wound is left open, or, at most, drawn together by a stitch or two. Puncture of the posterior vaginal vault and gauze drainage into the vagina should usually be added. Rapidity of operation and the smallest possible quantity of anesthetic are essential to success.

Salpingo-oöphorectomy for Puerperal Sepsis.—An acute pyosalpinx in the puerperium is very rare. It is uncommon for acute septic infection after labor to travel by the tubes alone. Infection usually occurs in the uterine muscle, the veins, the lymphatics, or the connective tissue of the pelvis. When the track of the septic inflammation is confined to the mucous membrane of the genital tract, the pelvic peritoneum, in a case serious enough to demand operation during puerperal convalescence, becomes infected, inflamed, and suppuration quickly follows, so that the operation is usually performed for an intra-peritoneal pelvic abscess. The tube may be found somewhat swollen, inflamed, dark red in color, containing a few drops of pus, with flakes of purulent lymph on its external surface, and its removal is required; but the pyosalpinx is a subordinate feature in the pelvic inflammation. It is the more subacute case, not usually requiring operation in the conventional period of the puerperium, that results later in a typical uncomplicated pus-tube.

Ovarian abscess is much more common than pyosalpinx. The infection may travel to the ovary, both by way of the tube and by the connective tissue or lymphatics of the broad ligament. In the latter case the whole ovary may be infiltrated with a thin sero-pus of a particularly virulent character, and, unfortunately, in excising the ovary the exposure of the infected pelvic connective tissue in the stump may lead to infection of the peritoneal cavity and to a diffuse suppurative peritonitis.

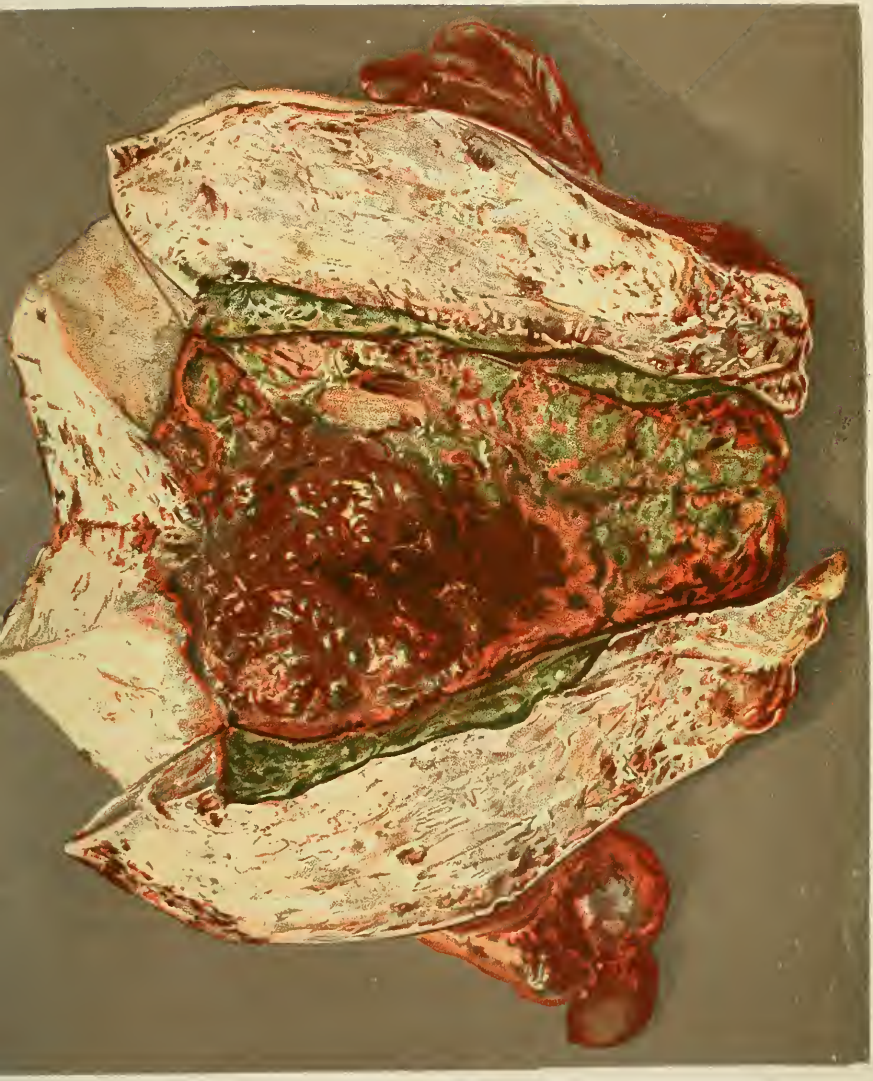
The commonest indication for salpingo-oöphorectomy is furnished by a pus-tube antedating conception or by a pre-existing gonorrheal infection of the genital canal. The strain of labor

excites a fresh outbreak of inflammation or leads to its spread, and the persistence of septic symptoms with the physical signs of pelvic inflammation justifies operative interference. Occasionally an operation must be performed on a presumptive diagnosis of old pus-tubes, based mainly upon the patient's history and the existence of serious septic symptoms, with tenderness on abdominal palpation over the region of the tube and ovary. The uterus is much too high in the abdominal cavity for a satisfactory pelvic examination of the uterine appendages.

There is often nothing peculiar in the technic of these operations. They differ, usually, in no respect from similar operations upon non-puerperal patients. The question of removing the uterus along with the tubes arises, however, rather more frequently than in the non-puerperal woman, on account of the infection of the endometrium or of persistent metrorrhagia. But in associated suppurative salpingitis, ovaritis, and infection of the connective tissue of the broad ligament, there is a modification of the ordinary technic, which is of vital importance. The tubes and ovaries should be excised, the blood-vessels of the broad ligaments tied separately; the cut edges of the broad ligament should be allowed to gape; the whole pelvic cavity should be filled with gauze and drained by a curved glass tube placed just posterior to the uterus. The dressings, sterile gauze and cotton, cover the tube and wound completely. They are not disturbed for twenty-four hours, when the tube is sucked out by a syringe. This is done daily for three or four days, when the tube is removed. The *gauze* is then withdrawn gradually, not being entirely removed for eight to ten days. Apparently most desperate cases may be saved by this technic.

Hysterectomy for Puerperal Sepsis.—Every physician who has seen many cases of puerperal infection during operations or post-mortem is aware that there are some in which the mere removal of infected tubes and ovaries, vaginal section and drainage, or the evacuation of pelvic abscesses through the abdomen can not be expected to save the patient. There remain infected and infiltrated broad ligaments infecting the peritoneal cavity, or there are foci of suppuration or infection in the uterine body that spread to the peritoneum or result in septic metastases. The only hope for the patient in such cases lies in the entire removal of all infected areas, leaving behind in the pelvis a healthy, non-infected stump. To effect this result the excision of the uterus, the broad ligaments, the tubes, and the ovaries is required. In addition to these cases there are others in which, if the tubes and ovaries must be excised, the uterus might be removed with advantage, on account of an

PLATE 17.



Streptococcic endometritis; pseudomembrane; hysterectomy (author's case).

infected endometrium or of persistent metrorrhagia. There may also be such wide-spread suppuration and disintegration of the broad ligaments, with tubal inflammation, that it is easier to remove all the infected area and to control hemorrhage, by a hysterectomy. Figure 555 represents such a case. A pyosalpinx antedated conception. Labor excited fresh inflammation. The infection spread from the tube downward through the connective tissue of the broad ligament, resulting in its partial destruction, in a thick infiltration at its base, and in an abscess between its layers, closely hugging the whole of one side of the uterine body. It was obviously impossible to remove the infected area without removing the womb as well. The operation, though undertaken under the most discouraging circumstances, was successful.

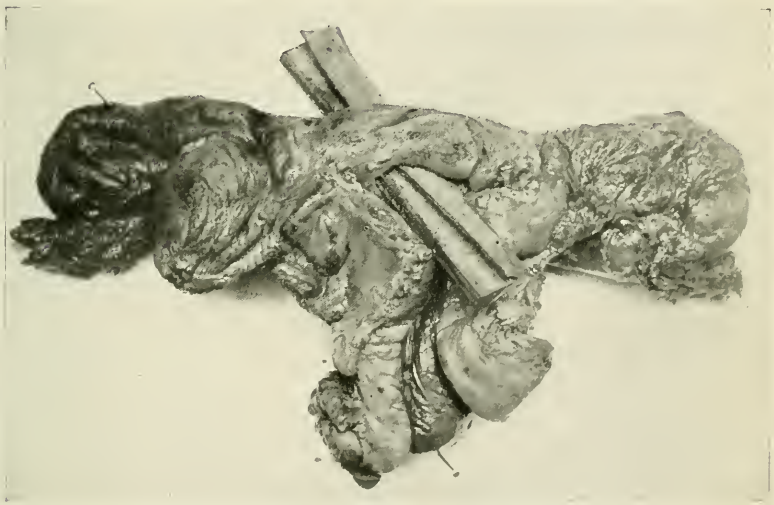


Fig. 554.—Perforation of the uterus in a self-induced abortion. Streptococcic infection of tubes and ovaries. Pan-hysterectomy.

There can be no doubt as to the necessity of hysterectomy in the cases represented in figures 554, 556, 557, and 558. There were abscesses in the uterine wall, directly under the perimetrium, about to break into the peritoneal cavity; one, indeed, did rupture during the operation. There was a septic ulceration at the placental site in one case so nearly perforating the uterine wall that by a light touch during the operation the forefinger passed into the uterine cavity. There was also a pyosalpinx in these cases that, judging by the history, antedated or was coincident with impregnation. The operations saved the patients. In another successful hysterectomy for puerperal sepsis, the author found the

Fig. 555.—Suppurative cellulitis of broad ligament; hysterectomy (author's case).

Fig. 556.—Suppurative and ulcerative metritis, salpingitis; hysterectomy (author's case).

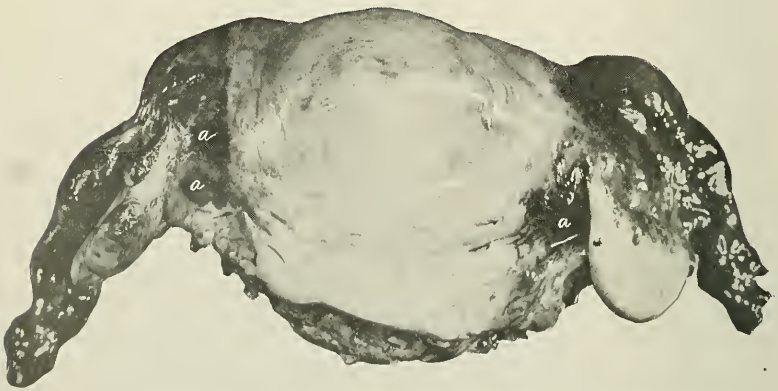


Fig. 557.—Suppurating metritis: *a*, *a*, *a*, Abscess cavities. Hysterectomy two weeks after labor. Recovery.

womb completely ruptured at the fundus from tube to tube. The diagnosis of the injury had not been made. The operation was undertaken some weeks after labor, for what was thought to be an intraperitoneal abscess. Areas of suppuration were discovered, but the greater bulk of the inflammatory mass was exudate which had shut off the general peritoneal cavity from

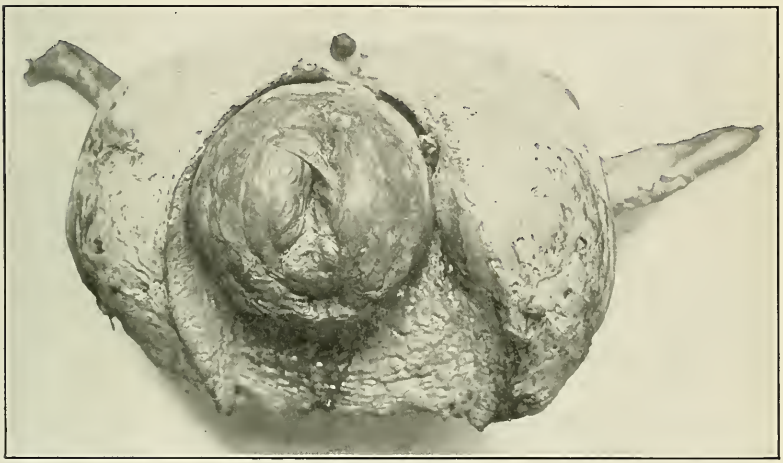


Fig. 558.—Submucous fibroma removed by hysterectomy in the early puerperium. (Author's case.)

infection through the gaping uterine wound. In cases of streptococcic infection the whole uterus may be found so necrotic that its consistence is that of cheese. No ligature holds in it and the uterine wall may be pinched through anywhere by the thumb and forefinger. One might as well expect a woman to live with a gangrenous coil of intestine in her abdomen as with such a gangrenous and necrotic uterus. She can only be saved, if at all, by a hysterectomy. It may also be necessary to remove the uterus in the puerperium to get rid of an infected fibromyoma, as illustrated in figure 558. This uterus was removed on the fourth day of the puerperium, the patient's temperature having been 104° and the pulse 140. Streptococci were found in the interior of the tumor and there was general systemic infection, with phlebitis and septic pneumonia, but the woman recovered.

Indications for the Operation.—The indications for hysterectomy during puerperal sepsis are furnished by the condition of the pelvic organs when they are exposed to sight and touch after the abdomen is opened. The conditions described are the types

calling for hysterectomy. It is not often possible to determine upon hysterectomy before the abdomen is opened, but it should be remembered that in any abdominal section for puerperal sepsis hysterectomy may be necessary. The surgeon, therefore, should be provided with the implements required for amputation of the womb in every abdominal section for puerperal sepsis, and should be prepared to remove it for any one of the indications described above, but should rest content with the least radical measure that promises his patient safety. The operation that is quickest done and shocks the patient least is most successful, provided, of course, that it is adequate. An excision of one or both cornua or of the fundus may suffice instead of a hysterectomy.

Technic of the Operation.—There are three points in which the technic of hysterectomy for puerperal sepsis may differ from the technic of the operation performed for other conditions: One is the necessity often of doing pan-hysterectomy; the other is the necessity often of tying the ligatures in a broad ligament much thickened by inflammatory exudate or by ligating the blood-vessels separately so as not to include an infected mass in the ligature. The third is the possibility of exsecting a portion of the uterus, usually the fundus or cornua, which are necrotic, while the rest of the uterus may be safely left.

The author prefers amputation of the uterus, leaving as little cervix as possible, unless an examination of the cervix by a speculum shows septic ulceration or exudate upon it or in its canal. The reasons for this preference for amputation of the womb over pan-hysterectomy are that the former can be done more quickly,

Fig. 559.—Suppurative ovaritis (rear view).

there is not the same anxiety about the cleanliness of the vagina, the suture material is more certainly guarded from infection afterward, and there is less danger of cutting or ligating the ureters.

The thickened broad ligaments are often a source of serious embarrassment in placing and tying the ligatures around the

uterine arteries. There is this difficulty to contend with in the majority of the operations. In some cases the inflammatory exudate within and below the ligature breaks down into pus, but an incision in the posterior vaginal vault evacuates the pus and secures an immediate disappearance of somewhat alarming symptoms. Vaginal hysterectomy is usually unsuitable for cases of puerperal sepsis on account of the danger of clamping or ligating large masses of infiltrated and infected broad ligament, on account of the stiffened and adherent broad ligaments, which make downward traction on the uterus difficult or impossible, and because it is impracticable in a vaginal operation to explore the pelvis and abdomen for foci of infection at some distance from the pelvic organs.

Fig. 560.—Streptococcus and staphylococcus infection of the endometrium: *a*, Necrotic layer of the endometrium; *b*, zone of inflammatory reaction; *c*, gland spaces; *d*, blood-vessels; *e*, remnants of glandular epithelium (Bumm).

Exploratory Abdominal Section for Puerperal Sepsis.—An exploratory incision should be made only in cases of suspected extraperitoneal pelvic abscess, to confirm one's suspicion, to be certain that none of the pelvic organs, especially the tubes, are diseased, and to determine the best situation for the incision to evacuate the abscess-cavity without contaminating the peritoneal cavity. This rule of practice would exclude exploratory abdominal section in cases with no physical signs of pelvic inflammation, but in which there is evident septic infection of a nature difficult to determine. There are possible exceptions to the rule, however, as in suspected pyosalpinx without physical signs, owing to the high position of the recently emptied womb and of its appendages.

Cases of true extraperitoneal pelvic abscess due to puerperal infection, and without intraperitoneal inflammation, are rare.

There are some gynecologists who deny their existence, but the writer has had a number of cases under his charge in which the diagnosis was established by abdominal section.

In some cases the suppuration is so evidently extraperitoneal than an abdominal section may be dispensed with.

Vaginal Section for Pelvic Suppuration or for Infection of the Pelvic Connective Tissue.—If there are physical signs of an abscess in Douglas' pouch and no evidence of involvement of the rest of the peritoneal cavity, or if the woman's condition is too bad to admit of an abdominal section, a colpotomy of the posterior vaginal vault and an irrigation of the pelvic cavity with sterile water is indicated. After cleansing the vagina with tincture of green soap and a sublimate douche, the mucous membrane of the posterior vaginal vault is incised with a knife, and then with sharp-pointed scissors or one's fingers the opening into the peritoneal cavity is completed. Adhesions are cautiously separated so as to avoid opening the general peritoneal cavity and the pelvic organs are carefully palpated to detect isolated foci of suppuration, which if found are opened. The pelvis is irrigated through a two-way catheter with sterile water and then packed quite firmly with a strip of iodoform gauze. The vagina is also packed. The pelvic packing is removed after two days or more and is replaced by a T-shaped rubber drainage-tube through which the pelvic cavity is irrigated daily with sterile water for ten to fourteen days. Incisions in the lateral fornices and gauze drainage are of service in suppuration of the parametrium or in accumulations of infected serum in it.

The Morbid Anatomy and Clinical History, the Diagnosis and Treatment of the Different forms of Infection and Septic Inflammation of the Genital Region After Labor.—The manifestations of puerperal sepsis differ with the various infecting bacteria that are lodged in the genital tract or have invaded the system, but especially with the organs or structures that are involved in the septic inflammation. The terms, therefore, "puerperal infection," "puerperal sepsis," or "puerperal fever," are generic in significance and include a number of distinct diseases, widely different in their symptoms, their prognosis, and their requirements for treatment. The lesions of puerperal sepsis may be found in the mucous membrane of the genitalia from the vulva to the abdominal orifices of the tubes, in the mucous membrane of the bowel, and of the urinary tract, the myometrium, the pelvic connective tissue, the peritoneum, the lymphatics, the veins, and in the parenchyma of the ovaries. Neighboring organs and tissues may be involved secondarily, as the bowels, appendix,

ureters, and pelvic nerves, and tumors of the pelvis and abdomen may be the starting-point of septic infection and inflammation.

Endocolpitis, Endometritis, and Salpingitis.—These inflammations are most often of the superficial suppurative variety, in which the prognosis is good, except in the case of the tubes, whence the inflammation may extend to the peritoneum, causing diffuse peritonitis or a circumscribed abscess near the fimbriated extremities, usually involving the ovary, or may result in a pyosalpinx.

The streptococcic inflammation of these membranes with an exudate and necrosis of tissue is much more dangerous. It may be localized in the vagina in the shape of ulcers near the orifice or extending up the wall to the cervix. It may be a diffuse, yellowish-green, foul-smelling exudate, occupying the whole interior of the uterus, in which streptococci, the bacillus pyocyaneus, the bacillus fœtidus, and the staphylococcus pyogenes albus or aureus are found. Under the necrotic layer of the endometrium there is a layer of granulation-cell infiltration upon which the woman's life depends. If it is well developed, it resists the invasion of the septic micro-organisms. If not, there is a likelihood of systemic infection of a grave character. In rare instances the Klebs-Löffler bacillus may be discovered in the pseudomembrane, showing that the case is one of true diphtheria, and the diphtheria of the vagina may be associated with diphtheria in the throat.[1] If the diphtheric inflammation affects the lower portion of the vagina, there is edema of the vulva in at least two-thirds of the cases.

Diagnosis.—The diagnosis of these inflammations is made in the case of vaginitis by inspection, in salpingitis by a combined examination, and in endometritis perhaps by the character of the lochia,[2] or by inspection of the cervical canal, which may be lined with the same exudate that covers the endometrium. The diagnosis between pseudodiphtheric membranes and true diphtheria can only be made by a bacteriological examination. It is most important that this should be done, for cases of true diphtheria should be isolated.

The treatment of these inflammations is frequently repeated irrigations of the whole genital tract. Sterile water is best for this purpose. An antiseptic simply diminishes the resisting power of the body-cells without destroying the micro-organisms that are

[1] J. W. Williams, five cases, *loc. cit.*, to which should be added one of my own, with diphtheria of the throat in the husband and true diphtheria of the vagina in the wife, demonstrated by bacteriological examination.

[2] A foul odor is not distinctive of anything except decomposition. The necrosis of the endometrium usually gives rise to this symptom. But the worst streptococcic infection may be associated with odorless lochia. There is usually, however, a profuse serosanguinolent or purulent discharge, but the lochia may be suppressed.

the cause of the inflammation. In cases of septic endometritis the systemic symptoms are grave, and a supporting, stimulating treatment is required in addition to the local treatment. In salpingitis a celiotomy may be demanded. If the inflammation is localized and the inflamed area accessible, it should be touched with a nitrate of silver solution, ʒj–fʒj.

Fig. 561.—Dissecting metritis (Liepmann).

Metritis and Cellulitis of Subcutaneous and Pelvic Connective Tissue; Septic Metritis.—As a later stage of septic endometritis all the structures of the womb may be involved—connective tissue, muscles, lymphatics, and often the veins, especially, however, the first. In the process of the inflammation portions of the uterine muscle may be undermined by ulceration and may slough off (dissecting metritis).[1] Liepmann reports a case associated with diabetes mellitus, and another with perforation into the bowel.[2] A limited area of uterine tissue may be involved, not larger in circumference, perhaps, than a dollar. The inflammation extends directly through the uterine wall, still confined within its original limits, until the peritoneal covering is reached. Here the inflammatory process is also strictly limited by the rapid development of adhesions which bind the womb to those structures in the peritoneal cavity nearest the diseased area. The uterus may be anchored to the caput coli, the anterior abdominal wall, and the sigmoid flexure. In these cases involution goes on imperfectly, of course, for the womb can not be normally reduced in size, held as it is at a high level in the abdominal cavity by adhesions. There are, however, besides the fixation and arrested involution of the womb, no other local evidences of inflammation, excepting some tenderness on pressure. It is usually impossible to locate the intraperitoneal abscess, by abdominal palpation or combined examination, on account of its situation.

[1] In 63 cases of dissecting metritis, Offergeld found a mortality of 25 per cent., "Deutsche. Med. Wochenschr.," No. 19, 1907.

[2] "Arch. f. Gyn.," Bd. lxx, H. 2.

The course of these cases is slow, but they are ultimately almost certain to be fatal, for an abscess commonly develops on the diseased area of uterine surface between the uterus and the structures attached to it, usually the bowel or omentum. A bacteriological examination of some of these cases has shown the presence in the uterine wall of pyogenic staphylococci.

If the pelvic connective tissue is involved, it is at first edematous. The serum is then absorbed, leaving a dense infiltrate, if there has been much cell-proliferation, or entirely disappearing if the cell-element is scanty.

The infiltrate, if not too extensive, is likewise absorbed in about four-fifths of all cases. Occasionally, however, in about one-fifth of the cases an abscess results, which may be opened above Poupart's ligament, or through the vaginal vault without entering the peritoneal cavity, but which may spontaneously rupture into the abdominal cavity, or may perforate the rectum, bladder, vagina, or uterus.

Diagnosis.—The diagnosis of metritis is difficult. The womb is large in size, the walls feel boggy, and the uterus is very sensitive to pressure; but it is almost impossible to be positive that metritis exists unless one can feel an abscess in its walls by an intra-uterine examination, or unless the collection of pus breaks into the uterine cavity.

If the abdomen must be opened for the septic infection, the condition of the womb is, of course, easily determined. Abscesses may be seen in its walls, and ulceration may so nearly perforate them that when the operator's finger is laid upon the peritoneal covering of the womb, it penetrates at once into the cavity.

The diagnosis of pelvic cellulitis is usually easy to establish. The exudate and infiltration can be felt on a vaginal examination. It is often, however, impossible to decide whether the inflammation is limited strictly to the pelvic connective tissue, or whether the pelvic peritoneum is also involved. If the exudate is situated only upon one side of the womb and does not involve Douglas' pouch, one has the right to suspect pelvic cellulitis without pelvic peritonitis, but in my experience it has almost always been necessary to open the abdomen before obtaining a positive answer to this question.

Treatment.—Occasionally, septic metritis ends in recovery by the discharge of pus-collections into the uterine cavity, or by the resolution of inflammation. But the worst cases demand hysterectomy. Cellulitis yields in the majority of cases to rest in bed, counterirritation, the ice-water coil or poultices over the lower abdomen, and hot vaginal douches. If it fails to do so, an

abdominal section should be performed, in order to be sure that the peritoneum is not involved. If the inflammation is found, after the abdomen is opened, to be confined strictly to the pelvic connective tissue, the abdominal wound should be closed, and the infected area, if it has suppurated, should be opened by an incision above Poupart's ligament, or through the vaginal vault.

Pelvic Peritonitis and Diffuse Peritonitis.—Pelvic peritonitis is the result of the extension of a septic endometritis, either through the tubes or directly through the tissues of the womb, or it follows pelvic cellulitis, the germs penetrating the peritoneum between the endothelial cells or through the lymphatic interspaces. In an extension through the tubes or by the spread of a cellulitis the ovary is likely to be involved, and an ovarian abscess develops. A leakage of lochial or catarrhal discharge through the abdominal orifice of the tubes is by no means uncommon. It is followed by a sharp localized peritonitis, though it is not certain that the discharge is always septic. It may be simply irritating. The infected or irritated region may be surrounded by large areas of peritoneal exudate. A large section of the abdominal cavity, one-fourth or more, may be thus, as it were, solidified.

On palpation, the abdominal contents feel hard as stone, with the muscles of the abdominal wall involuntarily fixed over them for protection, on account of great sensitiveness to pressure. Occasionally, the exudate communicates to the fingers a sensation as though snow were being kneaded through a covering of some flexible material. The symptoms are not alarming, and the common termination of this kind of peritonitis is recovery. The exudate is absorbed, the tenderness disappears, the temperature sinks to normal, and no ill-effects are left behind; but the exudate may break down and encapsulated abscesses may thus be formed, opening into the bowel, into the bladder, through the abdominal walls at the umbilicus, or possibly undergoing caseous changes.

General peritonitis after labor may result from an extension of pelvic peritonitis; from infection through rents in the vaginal or uterine walls; from the rupture of old pus-collections in the tubes or elsewhere in the pelvis; from putrefaction of tumors in the pelvis, as of dermoids and fibroids; from the transmission of pathogenic bacteria by the lymphatics, and from the extension of septic inflammation through the bladder-walls.

Perforating gastric and duodenal ulcers, ruptured abscesses in the spleen or liver, are possible causes of septic peritonitis in the puerpera.

If the suppurative peritonitis is not limited, the intestines are lightly glued together; are bathed in a thin pus, which lies in pools between their coils and are covered with a yellowish exudate, which can be stripped off, leaving a raw, bleeding surface.

There is a form of septic peritonitis so virulent and poisonous that no signs of inflammation accompany it, and the patient dies before pus or exudate can be formed (*peritonitis lymphatica*).

The abdomen is found, after death, filled with a dirty fluid, composed of serum, some blood, and numberless micrococci.

In all forms of septic peritonitis the coats of the intestines are paralyzed and tympanites is marked.

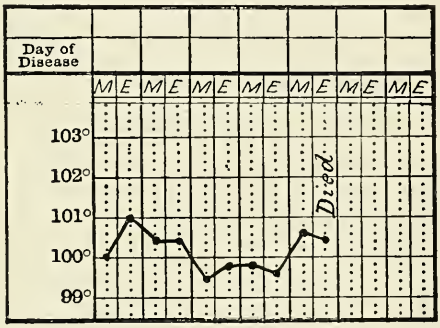


Fig. 562.—Temperature-chart of diffuse purulent peritonitis.

Diagnosis.—The diagnosis of pelvic peritonitis is made by the general symptoms and by the local physical signs. There is fever of varying degree, with accelerated pulse and general depression. There is marked tenderness over the lower abdomen, and there is tympanitic distention of the abdomen. Auscultation shows absent or feeble peristalsis. On making a vaginal examination exudate is found in Douglas' pouch and to the sides of the womb, which is firmly fixed. The exudate is usually exquisitely sensitive to pressure. It is sometimes firm and hard, and, again, may be soft and boggy. If the latter condition persists, it is indicative of suppuration.

General peritonitis is usually sudden in its onset and very rapid in its course. It occurs ordinarily in the first few days of the puerperium.

There is extreme distention of the abdomen ; a rapid, running, wiry pulse ; an extremely anxious, pinched expression of the face ; the eyeballs are sunk deep in their sockets and there are dark rings under them ; there is a peculiar grayish color of the skin, and,

perhaps, high fever, agonizing pain, and possibly dullness on percussion at certain points in the abdominal cavity; but the latter signs may be entirely absent. There may be absolutely no tenderness nor pain, no dullness, and very little fever. Malignant cases may end fatally within forty-eight hours from the first appearance of symptoms, with a temperature never exceeding 100½° by the mouth, though the *rectal temperature* is often much higher.

Fig. 563.—Clots in sinuses of uterine walls (from specimen in the Army Medical Museum, Washington, D. C.).

Treatment.—It is difficult to determine at first whether a pelvic peritonitis will end in suppuration or resolution. As the latter is always possible, the treatment should at first be expectant. Counterirritation and poultices may be used over the lower abdomen; an ice-bag or the ice-water coil is often of the greatest service; the bowels may be thoroughly drained by a strong purgative, so as to diminish intra-abdominal congestion and inflammation, and copious hot vaginal douches may be given. If the symptoms persist much beyond forty-eight hours in their original intensity under this form of treatment, suppuration has probably occurred, or must be expected. In such a case the abdomen should be opened. Abscesses, if they are found, must be evacuated and the cavities thoroughly cleaned, disinfected, and drained. Distended tubes and ovaries must be removed, and it may be necessary to perform hysterectomy. If the abscess is localized in Douglas' pouch, or if the patient's condition is very bad, vaginal section is preferable, followed by drainage through the posterior cul-de-sac.

General, diffuse, suppurative peritonitis is almost invariably fatal, let the treatment be what it may. The only possible chance for such a case is in the earliest possible performance of an abdominal section with free irrigation of the abdominal cavity and drainage through the abdominal wall, the flanks, and the posterior vaginal vault; but even though this be done within twelve hours of the onset of symptoms, it will almost invariably be of no avail. Once in a long while, however, a case of true diffuse suppurative peritonitis may be saved by a timely operation.

Fowler advocates raising the head of the bed after these opera-

tions, so that the patient's body has a downward slant of 30 degrees or more, to facilitate drainage.[1] Combined with Murphy's continuous instillation of salt solution in the rectum, it should be adopted in the after-treatment of operations for peritonitis, but nothing like the results Murphy reports can be expected in the streptococcic peritonitis, which is the form commonly seen after childbirth.

Uterine and Para-uterine Phlebitis.—The veins of the uterus and of the surrounding connective tissue are prone to thrombosis by reason of the sluggish circulation, the pressure during pregnancy, and the altered constitution of the blood in a puerpera. The clots, when formed, may be directly infected, usually at the placental site. They may then be disintegrated and swept into the circulation, producing pyemia, or the veins may be infected from passing through a septic region. Then the walls are first involved, the blood clots, and perhaps thus opposes the further spread of the process. Or, more likely, the clot is in its turn infected, disintegrated, and carried into the larger venous trunks. In the course of the inflammation clots may be dislodged or vessel-walls may be perforated and a most serious hemorrhage may result. Repeated bleedings may occur at short or long intervals. This form of septic infection is least likely to produce peritonitis or local inflammation in the pelvis, but is most likely to produce pyemia.

If infected emboli are swept into the circulation, they may find lodgment in many different parts of the body, causing abscesses in the abdominal viscera, the eyeballs, the brain or spinal cord, the lungs, the pleura, or in the subcutaneous connective tissue at any portion of the body-surface. I have seen, for example, the whole anterior portion of the left leg and the right forearm riddled with the abscesses of suppurative cellulitis in the course of a case of puerperal phlebitis.

The thrombosis in a puerpera is not always limited to the veins of the uterus and of the pelvis. I have observed, for example, a fatal case, death occurring on the seventeenth day postpartum, preceded by convulsions and coma. It was not known whether the woman had had fever after delivery. In the postmortem examination the longitudinal and lateral sinuses of the brain were found perfectly solid with thromboses. There had been a very severe postpartum hemorrhage, and there were evidences in and about the womb of septic phlebitis. Maygrier and Letulle report a case of puerperal thrombosis of the mesenteric vein with partial necrosis of the small intestine.[2]

[1] "Med. News," May 28, 1904.

[2] "Bull. Soc. Anat. de Paris," tome lxxiii, p. 507.

An almost constant accompaniment of uterine and pelvic phlebitis is phlegmasia alba dolens.

Diagnosis.—The characteristic signs of uterine and pelvic phlebitis are: a high, irregular, and long-continued fever; profound

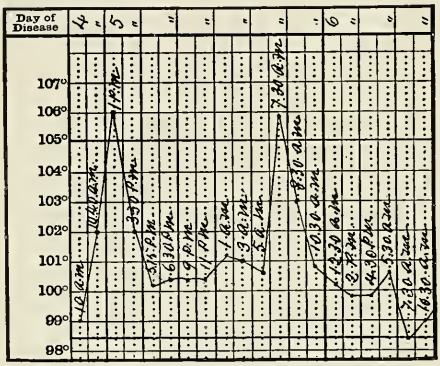


Fig. 564.—Case of phlebitis in which there was a sharp rise of temperature after two attempts to disinfect the birth-canal.

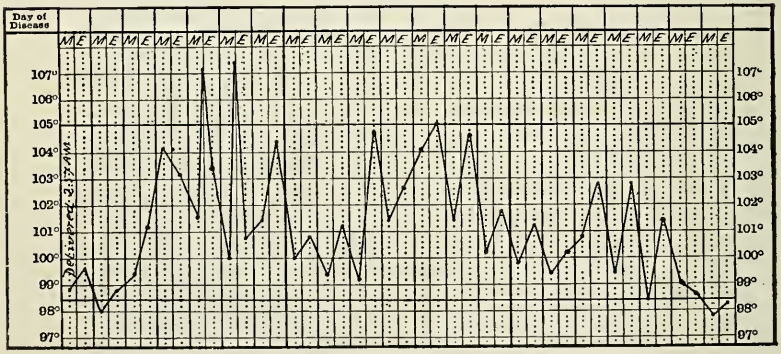


Fig. 565.—A case of phlebitis. Twice the temperature rose above 107°, as a result apparently of an intra-uterine douche, the hyperpyrexia occurring directly after it. Recovery.

depression and great rapidity of pulse, with an entire absence of all local symptoms of septic infection or of septic inflammation. The womb is normal in size, is freely movable, and involution goes on uninterruptedly. There is no tenderness, no tympany. Any interference with the uterus, as in an attempt to disinfect its cavity, occasions an exacerbation of the fever and may cause a serious hemorrhage. The woman's face is apt to show a dusky flush on one or both cheeks, and red splotches appear on other parts of the body, especially upon the chest.

In the course of the disease evidences of pyemia may appear, and phlegmasia alba dolens will almost surely develop, either as the predominant symptom or as a mere incident in the course of the disease. It is a common experience to note intermissions of apparently perfect health with a normal temperature lasting perhaps for several days and then a recurrence of all the symptoms in their original intensity.

Treatment.—The treatment of phlebitis should consist of a preliminary disinfection of the uterine cavity. In a perfectly typical case this will prove unnecessary or even harmful, but it is so difficult to determine whether or not there remains in the womb infected and necrotic endometrium, that the risk of doing the patient some damage should be incurred in order to escape the serious error of leaving in the uterus material which, if not removed, may result in her death.

The successful treatment of the phlebitis itself consists of absolute rest and stimulation. Enormous quantities of alcohol may be used with advantage, and as much food of an easily digested character should be administered as the patient can assimilate. The vast majority of these cases end in recovery, but the disease may run a course of weeks or months. On account of the danger of a recurrence of the symptoms the patient should be kept in bed for at least ten days after the temperature has become normal. It has been proposed to ligate and excise the ovarian and even the hypogastric vein in case of septic thrombosis in the former.[1] This treatment does not appeal to the author as reasonable (see p. 743).

Phlegmasia Alba Dolens, or Milk-leg.—This condition receives its name from the appearance that the leg presents, and from the old idea that most of the inflammatory conditions of the puerperium were due to a metastasis of milk. There are two distinct kinds of phlegmasia after delivery. In one there is an occlusion of the veins of the pelvis and of the lower extremities, interfering with the circulation and leading to an intense edema. The leg is enormously swollen; the skin is tense, glistening, and milk-white in color. The swelling is so great that the skin does not at first pit on pressure. In the other class of cases there is a septic inflammation of the connective tissue of the pelvis and of the thigh, the infection spreading from the perineum or from the deeper pelvic fascia through some of the larger foramina of the pelvis. Cases of the first class—thrombotic phlegmasia—are much more common than those of the second—cellulitic phlegmasia.

Thrombotic phlegmasia should be also divided into two classes. In one the thrombosis is primary, and is due to the pres-

[1] International Gynecological Congress, Rome, 1902.

sure to which the blood-vessels are subjected during pregnancy, to extensions of thrombi from the uterine sinuses, to stagnation of the blood-current. In the other there is a septic inflammation of the blood-vessel wall, leading to secondary thrombosis. The clinical manifestations are quite distinct in the two kinds of cases; in the first there is little fever and few systemic symptoms; in the second the fever is high and the systemic symptoms grave, but one often sees the first pass into the second by an infection of the blood-clot.

Symptoms.—Usually from the tenth to the thirtieth day[1] there develop a heaviness and stiffness in the leg, with pain, especially in the calf of the leg, soon followed by swelling, beginning at the ankle and gradually ascending to the groin, if the phlegmasia is due to thrombosis of the veins; or at Poupart's ligament or the buttocks, extending down the thigh, if the condition is due to a septic inflammation of the connective tissue. In the former case there is very likely to be tenderness along the course of the femoral vein, which may also be marked by a line of inflammatory redness. Other superficial veins may be likewise affected, and may appear as red streaks under the skin. The lymphatics may also be involved, becoming thickened and reddened. There is almost always slight fever, which usually precedes the swelling of the leg and disappears commonly long before the swelling subsides. There is also gastric and intestinal disturbance, with a foul tongue, loss of appetite, nausea, and vomiting. There is profound physical depression, sometimes with great restlessness and sleeplessness. There is often a dusky flush upon one or both cheeks.

Phlegmasia is a very frequent complication of septic phlebitis, in which disease it may occur as a mere incident, the swelling of the leg appearing, perhaps, during the height of the septic fever, lasting a comparatively short time, and disappearing entirely long before the subsidence of the other symptoms of the septic infection.

The left leg is more frequently affected than the right. Occasionally, one leg is involved after the other, and possibly they may both be swollen at the same time.

Frequency.—Phlegmasia is a comparatively rare disease.

As already stated, the thrombotic variety of phlegmasia is very much more common than the cellulitic kind. Of twenty-five cases or more under my observation, only one was of the latter sort.

Causes.—The commonest cause of phlegmasia is a septic inflammation of the blood-vessel walls, beginning at the placental

[1] Phlegmasia may antedate labor, and I have seen it appear seven weeks after delivery.

site and extending through the pampiniform or utero-vaginal plexuses down to the femoral vein, or upward through the spermatic vessels to the vena cava.

In consequence of the inflammation of the vein-walls the blood clots in the vessel, and the clot extends even more rapidly than the inflammation of the vessel-walls. Occasionally, the thrombus is the primary occurrence. This is proven by the cases which develop before labor. In these instances the pressure of the pregnant womb upon the pelvic vessels, the stagnation of the blood-current, and the composition of the blood all conduce to the formation of extensive clots. But even if the primary occurrence is a thrombosis, the clot usually becomes infected in time; so that almost every case of phlegmasia, some time in its course, is septic in its nature. It has been claimed by Widal that the thrombus of the femoral vein after child-birth is explained by the presence of pathogenic micro-organisms in the blood, which fasten themselves upon the vein-wall near Poupart's ligament, where the circulation is sluggish and stagnant, especially when the woman first stands up, and is favorable, on this account, to the deposition of bacteria along the walls of the blood-vessel. This theory very likely has some truth in it. It would explain the occurrence of phlegmasia in the course of infectious diseases, such as typhoid fever and grip; and it would also explain the thrombosis of other vessels than those in the pelvis, as, for instance, of the sinuses in the brain.

Prognosis.—The outlook in a case of phlegmasia is always somewhat doubtful; the dangers are manifold. There may be pyemia from the detachment of a portion of an infected clot; abscesses may develop in the vessel itself, extending rapidly to surrounding structures until the thigh-muscles are dissected one from the other by an ulcerative process and the whole limb becomes infiltrated with a foul sero-pus. The circulation may be so interfered with that gangrene of the limb occurs,[1] or the vena cava may be blocked up, practically cutting off the whole lower portion of the body from its blood-supply by preventing the return flow. Or, if there is only partial compensation for the obstructed circulation, there is a chronic congestion of the limb, which is permanently enlarged and stiffened, and will swell beyond its usual proportions if the woman is much upon her feet. The passive congestion, if long continued and exag-

[1] Wormser has collected 66 cases of puerperal gangrene, 58 in the lower extremities, 8 in the upper extremities, skin of the face and of the buttocks. The cause may be found in the arteries or in the veins. In the former there may be embolism, end-arteritis, and thrombosis. In 40 of the cases the arteries were alone obstructed in 18; the veins alone in 13; the arteries and veins in 13. ("Wiener klin. Rundschau," No. 5, 1904.)

gerated in degree, may even result in the development of elephantiasis.

Most to be feared of all is the detachment of a large portion of the thrombus and a consequent pulmonary embolism, with sudden death.

The most favorable course in these cases is absorption of the thrombus and the restoration of the circulation through the obstructed blood-vessel. The next most favorable termination is a firm organization of the thrombus, the obliteration of the vein, and a satisfactory compensatory circulation by means of the gluteal vessels or through the epigastric veins.

Treatment.—The most important features of the treatment may be outlined as follows: Absolute quiet and rest flat upon the back in bed, in order to avoid embolism; elevate the limb, in order to facilitate the return circulation as much as possible; wrap it in cotton, so as to alleviate the feeling of cold and numbness in it; and support the system by sufficient food and carefully regulated stimulus, as the disease is almost always asthenic in tendency.

When all symptoms have subsided, when the swelling has disappeared, and there is no longer the slightest tenderness along the course of the affected vein, the limb may be restored more quickly to usefulness by gentle friction and massage. The patient should not be allowed to leave her bed until about ten days after the complete subsidence of fever and local tenderness, for fear of embolism, which is always possible until the clot has become absorbed or is firmly organized.

In the cellulitic variety of phlegmasia the fever is much higher, the disease is more acute, and the inflammation more intense. There is almost a certainty of suppuration in the connective tissue of the thigh. The first formation of pus should be carefully watched for, so that the abscesses may be opened in time to avoid extensive burrowing. Extensive and multiple incisions may be required to evacuate the pus and to drain the diseased areas, even early in the course of the inflammation.

Abscesses may also develop in the phlebitic and thrombotic variety of phlegmasia, along the course of the femoral vein, in the popliteal space, or in the calf of the leg.

Septicemia, Sapremia, or Putrid Absorption.—By these terms is meant the absorption into the system of ptomains or toxins generated by the putrefaction of hypertrophied decidua, shreds of membranes, blood-clots, pieces of placenta, or of the lochial discharge.

This is quite a common form of septic fever after child-birth.

It is a frequent accompaniment of microbic invasion of the system. Not only anaërobic saprophytes but pathogenic bacteria of all kinds are productive of toxins. Occasionally, they are excluded from the uterine cavity entirely, in spite of the presence of large masses of putrescible material, as is proved by a fetal head remaining in the uterus three months, a placenta seven months, without disadvantage to the patient. Sapremia may appear late in the puerperium.

Of all forms of sepsis after child-birth, sapremia, if not associated with microbic invasion of the tissues beneath the endo-

Fig. 566.—Hypertrophied and angiomatous mass of infected decidua at the placental site ; hysterectomy (author's case).

metrium, is the least dangerous and the easiest cured. It may, however, at any time develop into one of the forms previously noted, and should never be neglected. It is not at all unlikely that streptococci and possibly other pathogenic micro-organisms in the uterine cavity may act as saprophytes. They are certainly often associated with the anaërobic micro-organisms of decomposition. If they are left there too long, they might invade the system.

Symptoms.—Usually in the first three days after labor the temperature rises and the pulse is accelerated. The womb is found larger than it should be, and the lochial discharge has a foul odor. Often, however, sapremia may develop very late in the puerperium. There may be no foul odor whatever to the discharges, and the involution may appear to proceed naturally.

An accurate diagnosis of sapremia is never possible, but if a

single disinfection and evacuation of the uterine cavity is followed by an immediate disappearance of symptoms, if blood cultures are sterile and there are no signs of local inflammation in the pelvis or abdomen, it is likely that the patient is suffering from septic intoxication and not septic invasion. An absence of pathogenic bacteria in the uterine contents is confirmatory, but even streptococci may act as saprophytes on the endometrium.

Treatment.—The treatment of this form of infection has been described in the general treatment of all forms of sepsis. It is a thorough disinfection and instrumental evacuation of the uterus. If the case is one of true sapremia, the success of this treatment is almost immediate.

Septic cystitis, ureteritis and pyelitis may be of the superficial, suppurative variety (staphylococcic), or may be diphtheric (streptococcic) with the formation of pseudomembrane.

In the latter case the exudate or membrane may extend from the bladder by the ureter to the pelvis of the kidney. There may be sloughing of the infected mucous membrane, putrefaction of the masses of membrane exfoliated, and extension of the inflammation through the bladder-walls to the peritoneum. The kidney may bear the brunt of the attack; it may be riddled with abscesses, or converted into a large bag of pus. From contiguity with the liver on the right side, hepatic abscesses may also be found.

Causes.—The most frequent cause is an imperfect aseptic technic in catheterization. It is possible, however, for micro-organisms to wander in by the urethra. The kidneys may possibly be infected from the blood and the bladder may be infected from foci in the pelvis. Anything which lowers the vitality of the urinary tract predisposes to infection; namely, pressure on the bladder by the fetal head; injuries; overdistention of the bladder; cystocele; dislocations of the kidney; renal calculus; and compression of the ureters. An infection of the urinary tract may have antedated labor.

Diagnosis.—The cystitis usually develops a few days after labor, with the ordinary signs of that affection—frequent and painful micturition, slight elevation of temperature, pus and mucus in the urine, and tenderness on pressure over the bladder. The symptoms may subside after a few days and the patient may appear to be in perfect health, while the inflammation is passing up the ureters, but fever returns with added intensity, and all the symptoms of septic infection may appear to a most alarming degree. The urine contains large quantities of pus and mucus, and swarms with micro-organisms. There is very likely tenderness on pressure over one or both kidneys, and there may be intense pain in the lumbar region.

At this stage of the disease a stimulating treatment may enable the patient to survive the immediate attack, though she may be left with a chronic pyelitis. She is, however, likely to die of septic infection of the kidneys.

Treatment.—Infection of the bladder should never be allowed to extend to the ureters and kidneys. On the first symptoms of vesical

Fig. 567.—Necrosis of an intraligamentary fibromyoma removed in the puerperium.

irritation and inflammation after labor, the bladder should be washed out and disinfected through a two-way catheter with at least a quart of a boric acid solution (15 grs.–f℥j). After the irrigation 4 to 6 ounces of a 2 to 5 per cent. protargol or argyrol solution may be injected into the bladder and left there until the next urination. This treatment usually stamps out the septic infection of the vesical mucosa in a few days, and there is no extension of the inflammation. If pyelitis develops, the urinary disinfectants, urotropin, boracic acid, salol, should be administered with large drafts of water. Stimulation and support are required. It may be necessary to open and drain the pelvis of the kidney on one or both sides by a lumbar incision. Rarely nephrectomy is indicated if the disease is unilateral. A perirenal abscess may require evacuation in the course of the inflammation.

The differential diagnosis of cystitis and pyelitis is made by cystoscopy, catheterizing the ureters, and a bacteriological examination of the urine. The pyelitis of gonorrheal or colon bacillus

origin antedating labor is to be differentiated from the puerperal infection, usually streptococcic. The latter is much more dangerous.

Septic proctitis may be the consequence of employing a badly infected syringe-nozle in the administration of an enema. It is only likely to occur in hospitals, and is extremely rare under any circumstances. I have seen one fatal case. The inflammation may be of a superficial suppurative or catarrhal (staphylococcic) or of a diphtheric character (streptococcic). The latter is almost certain to be fatal. The former may end in recovery.

Degeneration and Putrefaction of Pelvic and Abdominal Tumors.—The cystic tumors of the pelvis and abdomen, usually ovarian cysts, show a disposition to twist upon their pedicles in the puerperium, and they may thus become gangrenous. Dermoid cysts are particularly likely to undergo degeneration. Solid tumors (fibroids), from the squeezing and bruising to which they are subjected in labor, and from their low vitality, are likely to become necrotic. The diagnosis of these cases is not difficult. The presence of the tumor should be recognized, and inflammation or degeneration in it must be suspected if the patient develops fever and the signs of sepsis after delivery.

The *treatment* is the timely removal of the infected growth. If there is any elevation of temperature at all after delivery, the tumor should be removed at once, without waiting for indubitable evidence of degenerative changes in it.

Tetanus.—This rare disease of the puerperium is due to an infection of the genital canal by the tetanus bacillus. The microorganism may be conveyed by a dust-laden atmosphere, by actual contact with hands or implements that are infected with the germ, or by muddy water containing a heavy sediment of soil. The proximity of the lying-in room to a stable was held accountable for the disease in one case. In Vinay's 106 cases the placenta was manually separated in 20, a tampon was inserted in 17.

Heyse [1] claims that a tetanus infection is always a mixed infection, and that the way must be prepared for the tetanus bacillus by a preceding pathogenic germ, causing a septic endometritis or some other pathological condition along the birth-canal. This theory is not supported by the three cases under my observation, in each one of which a most painstaking post-mortem examination, conducted by a skilled pathologist, failed to reveal any septic lesion of the birth-canal.

The disease may break out at almost any time after confine-

[1] "Ueber Tetanus Puerperalis," "Deutsche med. Wochenschr.," No. 14, p. 318, 1894. Other cases have been recently reported by Meinert, "Archiv f. Gyn.," Bd. xliv, p. 381; Maxwell, "Jour. Amer. Med. Association," xxxiii, p. 224; Irwin, "N. Y. Med. Jour.," p. 324, 1892.

ment, but usually appears within the first two weeks.[1] It runs a varying course, sometimes ending fatally within a few days, in other cases lasting a number of days or weeks before the symptoms become aggravated enough to permit of a diagnosis. The fever may be very high, may be quite moderate, or may be altogether absent until just before death.

The prognosis is extremely grave; the mortality may be put at about 90 per cent.[2]

A curious mistake in the diagnosis of this disease has been brought to my notice on three separate occasions. In each of these cases occurring at quite long intervals of time, seen each by a different physician, the disease was taken for hysteria and was so treated for a number of days.

The treatment consists of the administration of huge doses of the bromids[3] and of chloral, with stimulants, and in a disinfection of the birth-canal. If a reliable tetanus antitoxin can be procured, it is advisable to try it.[4]

Suppuration of the Pelvic Joints.—Any of the pelvic joints may suppurate by the extension of an infectious inflammation or by a metastatic infection. The symphysis is, however, most often affected, usually in consequence of some injury during labor, which lessens the resisting power of the joint. An early diagnosis of suppuration in this locality should be made, and as soon as the observer can convince himself that the joint contains pus it should be freely opened and thoroughly drained.

The prognosis is fairly good. In the University Maternity we have had a good result in suppuration of both sacro-iliac joints.

Ischiorectal Abscess.—Suppuration in the ischiorectal fossa may occur in consequence of injury to this region during labor. I have one patient in whom an ischiorectal abscess developed regularly after some four or five successive confinements. The diagnosis of the condition is easy, and its treatment is a free evacuation of the pus and good drainage of the abscess-cavity.

The Relation of Infectious Fevers to Puerperal Infection, especially of Erysipelas, Diphtheria, Scarlet Fever, and Malaria.—A woman after confinement is more susceptible to the infectious fevers than

[1] Vinay ("Du tétanos puerpéral," "Archives de Tocol.," 1892, p. 791) collected 106 cases—47 after abortion, 59 after labor at term. After abortion the disease broke out in 21 cases during the first week; in 16 during the second; after labor in 19 cases during the first week; in 23 during the second. F. B Hancock and J. C. Hirst added 13 cases to Vinay's statistics, "University Med. Magazine," August, 1897.

[2] Vinay found a mortality of 88.67 per cent. In surgical cases the mortality has been 89.7 per cent.

[3] Camphor, and opium are also advised.

[4] Baccelli's method may also be tried, the subcutaneous injection of large doses of carbolic acid in weak solution.

she is at other times. Her lowered vitality and perhaps the reception of the poisons of these diseases into the genital tract make the period of incubation shorter and the disease itself more violent in its manifestations and more fatal in its results. Thus, measles, a disease ordinarily of low mortality, is much more dangerous during the puerperium.

It is therefore incumbent upon the practitioner of medicine to abstain from obstetrical work altogether, if possible, while in attendance upon cases of exanthematous fever or upon diphtheria. It is not sufficient for the physician to depend alone

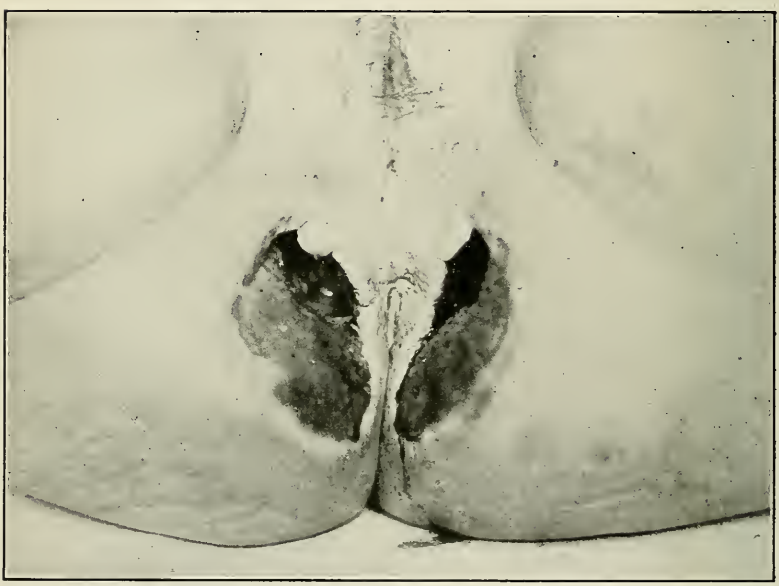


Fig. 568.—Bilateral ischiorectal abscess, slough of the gluteal muscles, and perforation of the rectum after labor. Cured by drainage and irrigation. (Author's case, Philadelphia Hospital. Patient supposed to be syphilitic.)

upon thorough disinfection of his hands and arms in such cases; his hair, clothing, skin, and breath may convey the contagion to the puerpera, who will absorb it, perhaps, not only by the ordinary channels, as by the throat in diphtheria, but also by the genital tract as well.

Cases are reported in which a recently delivered woman had at the same time diphtheritic exudate containing the Klebs-Löffler bacillus upon the pharyngeal and upon the vaginal mucous membranes. If a physician can not escape the necessity of attending a woman in child-birth while in attendance upon contagious diseases, he should take a full bath, should rinse his mouth

and brush his teeth with an antiseptic mouth-wash, should change his clothing throughout, and should be as long as possible in the open air afterward before he sees his parturient patient, in addition to observing a careful aseptic technique in his examinations of the patient.

Erysipelas.—The connection of erysipelas with puerperal infection may be dismissed in a few words. Modern bacteriological research points to the identity of the streptococcus pyogenes and the streptococcus erysipelatis. The production of pus and internal inflammation or of an efflorescence upon the skin is simply a question of virulence and of situation. It is not surprising, therefore, to hear of such experiences as those of Winckel, who has found germs in abscesses of the pelvis after labor that on inoculation produced erysipelas, and who has seen one of his nurses, after catheterizing a febrile patient, develop erysipelas of the face from a drop of the lochial discharge that splashed upon her nose.

Other clinical facts are also easily explicable by the identity of the pyogenic and of the erysipelatous streptococci. In the course of puerperal infection, erysipelas may appear upon the labia and spread thence down the thighs or over the trunk. If the patient, on the contrary, contracts erysipelas in some portion of the body remote from the genitalia, as upon the breast or face, the disease may run its ordinary course without symptoms of infection of the genital tract and without great danger to life ; but if the infection spreads to the genitalia or has its origin there, the danger of death is great.

Diphtheria.—The connection between diphtheria and epidemics of puerperal infection has been demonstrated beyond a doubt by a vast amount of clinical observation. To select a single example out of many : One of my young friends and former students lost two healthy women in a week from puerperal sepsis while he was in attendance upon a child with diphtheria.

He had never had a serious case of puerperal infection before, and he has not had one since. The Klebs-Löffler bacillus has been found in two cases of vaginal exudate under my notice in Philadelphia. As already stated, the mere disinfection of the physician's hands and arms is not enough to protect a woman against this malignant disease. Complete change of clothing, including the shoes ; a thorough soap and hot-water bath, with scrubbing of the hair, face, and exposed portions of the body ; brushing of the teeth, and gargling of the throat with an antiseptic wash, such as listerine, and a purification of the lungs by prolonged exposure in the open air, are necessary precautions.

Scarlet Fever.—Contrary to the opinion expressed by some

authorities, scarlet fever in the puerperium is rare. The comparatively frequent occurrence of septic erythemata has led to the erroneous belief that scarlet fever is a common cause of septic infection after child-birth. The same rule obtains in the case of scarlet fever in the puerperium as in other infectious diseases during that period—namely, the woman is more susceptible to contagion, the period of incubation is shorter, and the disease is more dangerous than at other times. During pregnancy the woman is particularly resistant against the poison of scarlatina. She may carry it about with her while pregnant, and may only yield to it after child-birth. As evidence that the poison of scarlatina finds an entrance into the body through the mucous membrane of the genital tract, it is interesting to observe that in the puerperium the rash is more marked upon the lower portion of the body, and that the throat symptoms may be entirely absent or very mild.

Malaria.—The puerperal state excites almost surely a fresh outbreak of malaria that is latent in the system, even though it has been dormant for years. There is no special predisposition to infection during the puerperium.

The differential diagnosis of malaria and sepsis may be puzzling at first, but the past history of the patient, the leukocyte count, the microscopic examination of the blood, blood-cultures, cultures of the lochia, and the therapeutic test usually suffice to clear up all doubt in twenty-four hours. To be on the safe side in doubtful cases it is wise to disinfect the genital tract, as well as to administer antimalarial treatment.

PART VI.

OBSTETRIC OPERATIONS.

CHAPTER I.

Aseptic and Operative Technique.

The Hospital Operating Room.—The requirements for a modern operating room differ as the room is designed simply for operative work or for instruction of students in addition. In the former case the following considerations should be taken into account: The floor and walls are made of non-absorbable, easily cleansed material. For the former, white hexagonal tiles, and for the latter, glass wainscoting, are the best. The room should be heated to 90° F. There should be no draughts of hot air to blow dust about. The best heating apparatus is a coil of heavy nickel-plated tubes for hot water or steam. The floor should have a vent for the water with which it is flushed.

The light is furnished by a skylight and windows, so that it is both vertical and horizontal. The light should be from the north. The cut in the roof and wall should be continuous, the glass in the wall and the roof having no intervening structural work except light iron frames. Small hot-water or steam pipes should run along the iron frames of the window and skylight, to prevent chilling the air by the large glass surface, the creation of draughts, and the "sweating" of the glass. A cluster of eight or ten incandescent electric lights should be suspended above the operating table, and there should be one or more plugs in the wall for the attachment of hand and head lights.

The sterilizing outfit should comprise two autoclave sterilizers, a water sterilizer, an instrument sterilizer, and an implement sterilizer for basins, pitchers, etc. The sterilizers may be in an adjoining room, but it is more convenient to have them in the operating room itself, if possible, in recesses out of the way and yet accessible. A trough should be provided long enough for three men to stand in front of, in which sterile basins are placed for the hand cleansing. This trough should have hot- and cold-water spigots with pedal stops, although tap water is not used for the hand cleansing.

The ordinary furniture of an operating room—glass cases for dressings, glass-top tables, basin stands and basins, enameled iron stools, apparatus for normal salt injection, materials for hypodermic stimulation—is naturally required. There should be a transformer or a transformer and a motor, as the electrical current is alternating or direct for electrically heating the cautery knife, the electric clamp, and the electric cautery. The instrument cases and instruments should be kept in an adjoining room, as they may be rusted by the moist hot air of the operating room.

A clinical amphitheater for demonstrating pelvic and abdominal surgery to medical students should have ample floor space, so that the operator and his assistants shall not be un-

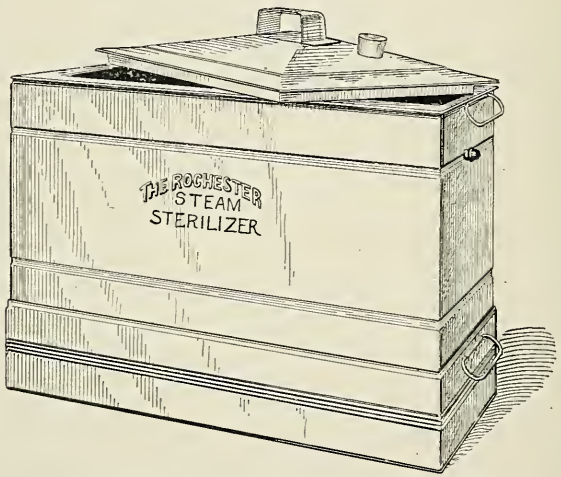


Fig. 569.—The Rochester sterilizer for dressings, etc.

comfortably crowded, and to provide room for two or more operating tables in use at once. In the limited time at the disposal of the teacher, closing the abdominal wound should be relegated to competent assistants, so that two or three abdominal or pelvic operations may be shown in the hour.

The sterilizing plant should be in view of the students, and they should also witness the hand-cleansing process, day after day, so that it may be thoroughly familiar to them. The operator and his assistants should don their head coverings, gowns, and gloves before the students. In short, the whole process of preparing for an operation should be regularly exhibited until at the end of a session each step is so familiar that it could not well be forgotten.

The Private House Operating Room.—In a private house the room selected for an operation should be near that in which the patient lies in bed. For an abdominal or vaginal section, shorten-

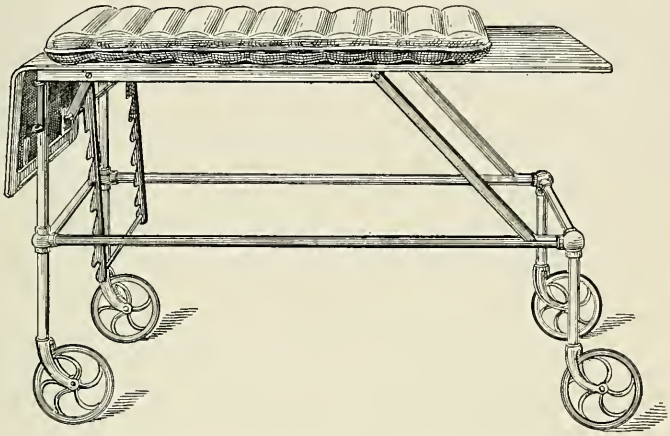


Fig. 570.—The author's operating table, of enameled iron with inflated air-cushion.

Fig. 571.—Lilienthal's portable operating table in its case.

ing of the round ligaments, and suspending the kidney, the furniture, carpets, and hangings should be removed.

The floor should be scrubbed with soap and water, and then mopped with a sublimate solution, shortly before the operation, so that it shall be damp and no dust will be raised by walking over it. For a vaginal operation it suffices to tack over the carpet a sheet which has been wrung out in a sublimate solution, but is left moist.

The basins and pitchers are boiled in a large clothes-boiler. The dressings and ligature material are sterilized either in the cage of a hospital autoclave, which is transported to the house wrapped

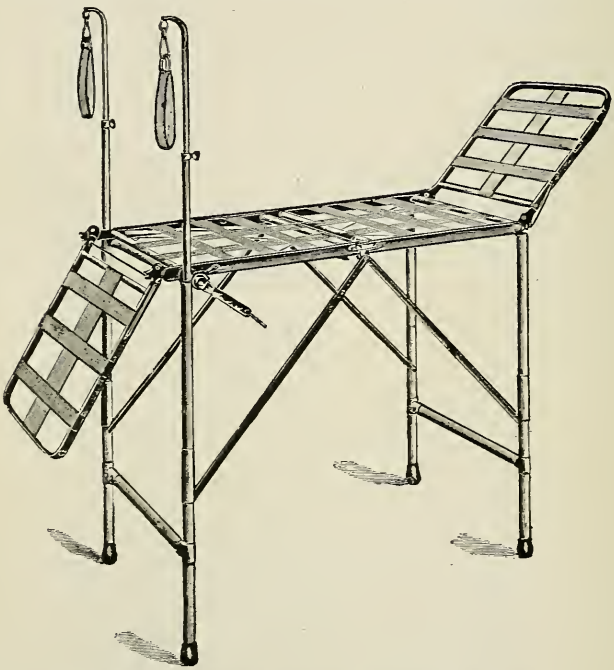


Fig. 572.—Lilienthal's portable operating table, set up.

in double sheets, or in the house itself in a Rochester steam sterilizer.[1] A large quantity of boiling water is on hand at the hour of operation, and boiled water is provided in pitchers with towels over their tops, plainly labeled on a strip of rubber adhesive plaster, so that water and sublimate solutions shall not be confused. Two small tables from the household furniture, draped with sterile sheets, suffice for the instruments and pads. Another table, similarly protected, is needed for the autoclave cage or the steam sterilizer.

[1] The 18-inch size oblong sterilizer can be packed and put in the autoclave, where it is sterilized under pressure. It is packed in a case, transported to the house, and resterilized just before the operation.

The **operating table** should be simple in construction, light in weight, easily moved on large rollers, with a quickly and easily managed hinged arrangement for the Trendelenburg posture. Supports for the shoulders are provided to hold a patient in the Trendelenburg posture. An air-cushion, covering almost the whole length of the table, is useful, as it saves the patient a great part of the backache usually complained of after operation and keeps her

Fig. 573.—Kitchen table draped with a sheet and Edebohls' leg supports attached.

warmer than a glass or iron surface would. It is possible, but not advisable, to fill the cushion with hot water. There is danger of burning her back if the temperature of the water is not carefully regulated. The table is provided with the upright leg supports and stirrups for the feet. A good portable table is a great convenience in private house operations. The table shown in figure 572 is the most satisfactory. It is light (28 pounds), portable, strong, and easily managed, giving the various postures required in gynecic surgery.

For plastic operations the Edebohls clamps and leg supports, which can be attached to any kitchen table, are a cheap and satisfactory substitute for a specially constructed operating table. Leg-holders, such as Robb's and Clover's, are not so convenient, and it is difficult to keep them clean. If a leg-holder is used, one should be improvised with a clean sheet.

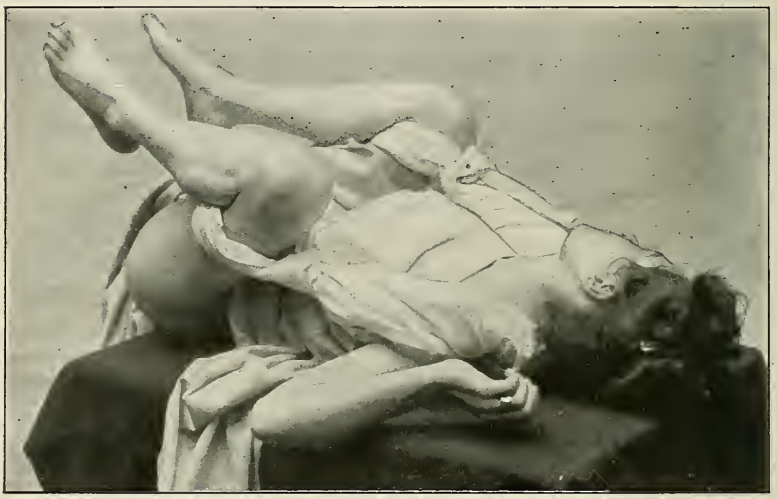


Fig. 574.—Improvised leg-holder with twisted sheet.

Hand and Skin Cleansing.[1]—There is no known method by which the human skin can be made sterile. It can be so well cleansed, however, as not to be a dangerous source of infection unless the operator has contaminated his unprotected hands with some particularly virulent micro-organism, such as the streptococcus of purulent peritonitis. The question of the best method of hand cleansing is not now such an anxious one, as the surgeon must wear rubber gloves uniformly, no matter what system of skin cleansing he uses, and should cover his arms with a long-sleeved gown. The insertion of the bare hand in a wound or body cavity is unjustifiable in the light of our present knowledge. But the gloves may be pricked or torn during an operation, so that the hands under them must be made as clean as it is possible to get them. The skin must be freed of all superficial epidermis scales; the sebaceous matter must be removed not only from the surface, but from the crypts in the skin; the nails, the opposed and palmar

[1] See "Händereinigung, Händedesinfektion, und Händeschutz," Haegler, 1900; and "Beiträge zur Händedesinfektionsfrage," Schaeffer, 1902. Also "Weitere, Beiträge zur Händedesinfektion," "Monatsschr. f. Geb. u. Gyn.," Bd. xix, 1904.

surfaces of the fingers, should receive particular attention. The method should be as simple and uncomplicated as is consistent with the best results.

The following principles of skin disinfection must be remembered to secure the best results: Mechanical cleansing is better than chemical disinfection; the best chemical disinfectants are chlorin and linsol.

The following system is employed by the author because he believes it to be efficient and not too complicated and because the bacteriological examinations have shown as sterile a condition of the skin as is secured by any method: Three sterile basins, three small glass dishes, and a tub (for sublimate solution) are provided. The basins are for the hot water, the glass dishes for tincture of green soap. Three medicine glasses, each with 2½ drams of linsol,[1] are placed near the trough on a glass table, and on this same table are two flasks, one containing alcohol, the other acetic acid, f℥ij, calcium chlorinate ℥iv, sterile water, Oij. A package of sterile wash-rags is placed near the scrub-up outfit and a metal powder-shaker, filled with grated sandsoap which has been sterilized in the autoclave, is near at hand. Six brushes are sterilized in the autoclave. The three basins, each with a small glass dish of tincture of green soap beside it, are placed in a long trough, in front of which the operator and his two assistants stand side by side.

The nails are cut short. The hands and arms to the elbow are scrubbed for ten minutes by the clock in the following manner: The basins are put in a row in the trough and filled with sterile water. A sterile wash-rag dipped in the water, spread out on the physician's hand, is thickly dusted with grated sandsoap by the nurse. The physician scrubs his hands and fingers with a rotary motion of the rag. In no other way can the apposed finger surfaces be got at so well. In three minutes the water in the basins is changed. A sterile brush is taken, dipped into the glass dish containing tincture of green soap, and with it the hands and arms are vigorously scrubbed. In three minutes the water is again changed, and this time the 2½ drams of linsol is poured into the basin, making, with the water in it, about ½ per cent. solution. The hands and arms are again scrubbed for three minutes, making nine in all. The basins are emptied and filled again with sterile water; the hands and arms are rinsed for a minute. Fresh brushes are then taken from the autoclave cage. The nurse pours on the hands, arms, and brush alcohol from one of the flasks; the arms and hands are scrubbed

[1] Linsol is an improved lysol: It is saponaceous, and has the following germicidic power: In a 1 per cent. solution it destroyed 40,000,000 colon bacilli in thirty seconds; 58,000,000 staphylococci and 2,000,000 streptococci in the same time (Philada. Clin. Laboratory). By mixing equal parts of lin. sapon. moll. and liq. cresol. com. an equivalent antiseptic may be obtained.

vigorously for a minute; then the chlorine water is poured in the same way from the other flask and another minute is devoted to a scrub with it. Finally, the hands and arms are immersed for a minute or two in a 1 : 1000 sublimate solution. The whole process lasts thirteen to fifteen minutes. One cleansing ordinarily suffices for an operating day. Ten to twenty operations on six to eight patients in succession are performed, with a change of gowns and gloves after each operation. If a glove is pricked and a finger is contaminated, a two-minute scrub with a 1 per cent. solution of linsol suffices. A basin of this solution and a supply of sterile brushes are ready for this purpose.

Fig. 575.—The surgeon's dress, with Vienna operating mask.

The operating suit is made like pajamas. It is sterile. The gown must have long sleeves to the wrist. Canvas rubber-soled shoes should be worn. The head is covered by a cap; the breath filtered through the Vienna operating mask. The hands are covered with sterile gloves. This is the author's technic for major surgery. For minor operations and obstetrical examinations a five-minute scrub with tincture of green soap and hot water, followed by alcohol, and a rinse in sublimate solution is sufficient. The gown, cap, and mask are omitted.

In sterilizing gloves they should be well powdered with talcum powder, folded between layers of gauze, and further protected by muslin. They should be laid out flat in the autoclave, sterilized, and put on dry. For obstetrical operations necessitating deep insertion of the hand in the uterus, long gauntlet gloves must be worn. It is difficult to put them on dry, so they are boiled and put on by pouring a little sterile glycerin into them.

The Preparation of the Patient for an Abdominal Section.—*The Afternoon before Operation; Skin Cleansing.*—Prepare rubber gloves by wrapping in gauze and dry sterilization. Clip pubic hair with clipper and shave with a safety razor. Sterilize the following articles for forty-five minutes at 240° F.: Two hand brushes for nurse; two soft-bristle brushes for patient; ab-

sorbent cotton; four small sheets; one-half dozen towels; gauze, unmedicated; gauze pad; binder; long-sleeved gown.

The nurse who cleanses the abdomen must prepare her hands and arms as though about to operate, namely: Cut nails short; scrub hands and arms with brush, hot water, and tincture of green soap for ten minutes, with four changes of sterile water in sterile basin; clean nails with boiled nail-file; with fresh brush scrub hands and arms with alcohol; immerse hands and arms in bichlorid solution (1: 1000) for two minutes. Then put on the long-sleeved gown and gloves.

The abdomen, from the ensiform to symphysis and from flank to flank and one-third the way down the thighs, must be scrubbed

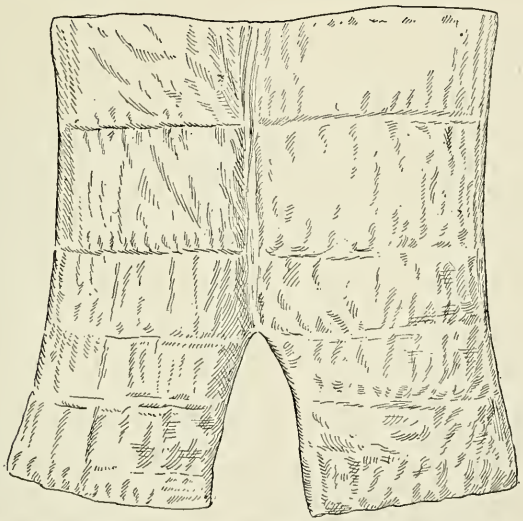


Fig. 576.—Gauze pad for patient's abdomen, extending part way down the thighs.

with soft-bristle brush, tincture of green soap, and hot water thoroughly (for ten minutes by the watch, with four changes of sterile water), paying special attention to navel and to pubic regions. Scrub thoroughly with alcohol with the second sterile soft-bristle brush. Cover the abdomen with the sterile gauze pad and put on the binder.

Morning of the Operation.—Give 2 ounces of clear beef-tea at 7 o'clock; give enema of pint of soapsuds, 1 dram of turpentine. Hands of nurse cleansed as described above. Articles resterilized as described above. Same cleansing of abdomen repeated as described above, but, in addition: Before alcohol scrubbing, scrub abdomen with 1 per cent. linsol solution; wring out the large

sterile gauze pad in 1 per cent. formalin solution, and cover the abdomen with it; put over it a thick layer of sterile cotton; apply binder. Catheterize the woman just before anesthetization with sterile glass catheter (in all cases of abdominal tumor the long silk or rubber catheter,[1] previously boiled, to be used) in aseptic manner. Give vaginal douche, 1 quart of 1:4000 sublimate solution, followed by a little sterile water. Pack the vagina with sterile gauze. Packing always to be removed in twenty-four hours at most or directly after the operation.

The patient is dressed for the operation in Canton flannel leggings covering the feet and reaching to the hips, and in a short gown, open down the back, reaching only to the hips.

The Preparation of the Patient for a Plastic or any Vaginal Operation.—*Evening Before.*—Sulfonal or trional, gr. xv, if she is sleepless or nervous. Epsom salt, one-half ounce in tumblerful of water at 9 o'clock.

Morning of Operation.—Cup of beef-tea at 7 o'clock. Enema of soapsuds and turpentine. Irrigation of lower bowel by repeated injections until it is completely emptied. Wash pubis and labia with gloved hands, using tincture of green soap, hot water, sublimate solution, and pledgets of sterile cotton. Shave pubis and labia. Wash out vagina with tincture of green soap and pledgets of cotton. Give douche of 1:4000 bichlorid solution followed by sterile water; tampon vagina with sterile gauze. Catheterize patient just before anesthetization with sterile glass catheter in aseptic manner.

If a vaginal tampon is inserted after an operation, it must never be left in longer than twenty-four hours, except by order of the chief. Douches after a plastic operation to be given only by order of the chief. The number of stitches to be removed must invariably be noted on the chart.

Ligatures and Sutures.—Catgut, silkworm gut, and Pagenstecher's celloidin thread are the only materials employed. The catgut is in three sizes, 0, 1, and 3. Sizes 0 and 1 are used for continuous sutures; 3 for some of the interrupted sutures, as in trachelorrhaphy, and for ligatures. The finest size only of celloidin thread is used.

The celloidin thread is rolled on reels, put in glass tubes stoppered with cotton, and given fractional sterilization on three successive days in the autoclave. The silkworm gut is boiled.

The catgut is prepared as follows:

Twelve hours in benzine.

Twelve hours between sterile towels.

[1] In case of abdominal tumor the bladder is sometimes sacculated or lifted high into the abdomen, and a short catheter will not evacuate it.

One hour in formalin (5 per cent.).
Twelve hours in chromicizing fluid.

Formula for Chromicizing Fluid:

Potassii bichromate,	1.5 parts
Acidi carbolici,	10 "
Glycerin,	10 "
Aq. destil.,	480 "

Eighteen to twenty-four hours in sterile water (first six hours under running sterile water).

Two nurses then scrub up as if for operation, and use long-sleeve gown and rubber gloves.

The catgut is tied one end to another and wound firmly on sterile metal cylinders, then stretched on a wooden frame which has been covered with sterile bandage.

The table the catgut is prepared on should be covered with sterile rubber sheeting, and over this a plain sterile sheet.

After the catgut is stretched on the frame it should dry for at least four days, then cut in lengths for sutures (about 36 inches). It is then wound on glass spools about 6 inches long, five sutures of fine on one and five of heavy on the other. The spool is then put in a metal cylinder with screw cap, and a solution of alcohol, 9 parts, glycerin, 1 part, is poured in. The cap is then fastened on tightly and put in a sterilizer. It is then sterilized in a hot-air oven for one hour at 300° F.

For the surgeon without hospital facilities the Claudius iodine gut is recommended—namely, gut soaked for eight days in a solution of ½ part iodine, 1 part iodide of potassium, and 100 parts water. The original Claudius solution of 1 per cent. iodine makes the gut too brittle.

Anesthesia.—Nitrous oxide gas followed by ether on gauze by the drop method is the routine system recommended. Pregnant women, however, should never be given nitrous oxide gas. It asphyxiates the fetus. For all operations on pregnant and parturient women chloral chloroform is used. Chloroform is also recommended in case of any kidney or lung complication; for brief anesthetizations and for air distention cystoscopy with the patient in an exaggerated Trendelenburg position.

Instruments.—The particular instruments required in the various operations are described in the appropriate place. All metal instruments are sterilized by boiling in water for at least twenty minutes, except the knives, which are kept immersed in a 5 per cent. solution of carbolic acid in alcohol to preserve a keen cutting edge. The instruments common to all surgical operations, such as hemostats, should be provided in an invariable number, and all should be accounted for before closing a body cavity.

Each operator will consult his own convenience or fancy in the arrangement of his instruments for use, but it is a safe plan to keep them in the receptacle in which they have been boiled, which, therefore, should be ample in size and provided with compartments, each containing instruments of one kind.

CHAPTER II.

The Artificial Dilatation of the Cervical Canal and the Operations to Deliver the Embryo and Fetus.

THE ARTIFICIAL DILATATION OF THE CERVICAL CANAL.

It is necessary to dilate the cervical canal artificially for mechanical dysmenorrhea; for sterility; to explore the interior of the uterus with the finger and with instruments; in cases of rigidity of the cervix, or when it is desired to hasten labor for any purpose. The os may be dilated by rubber bags, by graduated bougies, by the fingers, by pulling the head down with forceps, by taking hold upon a foot or leg in a breech presentation, by discission of the cervix, by multiple incisions, or by branched dilators.

Hydrostatic Dilatation.—For this purpose two kinds of rubber bags are employed. One of a cone shape (Voorhees) and of graduated sizes, the other consisting of two bags, one within the other; the first like Voorhees' bag, the other the shape of the birth-canal at the moment of its full dilatation (Pomeroy's bag, Fig. 577). To insert one of these rubber bags, it is rolled upon itself, grasped in an Emmet curetting forceps, or with the forceps that comes with the Champetier de Ribes bag, well smeared with sterile glycerin, and passed into the cervical canal, so that it enters the lower uterine segment. The tube is then attached to the nozzle of an aseptic graduated metal syringe and the bag is distended with water. It is well to test the capacity of each bag outside the woman's body to avoid overdistention and the danger of bursting. When the bag is filled, the rubber tube attached to it is clipped with a hemostat, a knot is tied in the tube below the hemostat, the latter is removed, and the tube is tucked into the vagina, which is then packed with gauze. Each of the progressively larger bags is inserted in the same manner, and allowed to remain in place from fifteen minutes to several hours, according to the time at one's disposal. The tube may be pulled upon by the nurse or attendant every two to five minutes for about a minute at a time

to hasten the dilatation of the cervix, in which case the packing may be removed from the vagina and the tube be left hanging out. Pomeroy's bag is rolled into as small a compass as possible, grasped

Fig. 577.—Pomeroy's bag distended with water.

Fig. 578.—Pomeroy's bag collapsed, rolled on itself, and grasped by the Champetier de Ribes forceps.

with the Champetier de Ribes forceps, well anointed with sterile glycerin, and inserted into the lower uterine segment, so that the

579.—Aseptic metal piston syringe.

internal bag when dilated will be caught by the cervix and will not slip out. The internal bag is first dilated, then the external bag. The instrument is exceedingly efficient in multipara, the whole

birth-canal being completely dilated in little more than an hour. The Champetier de Ribes bag (Fig. 580) is clumsy and is not much used in America. Barnes's bags have become obsolete.

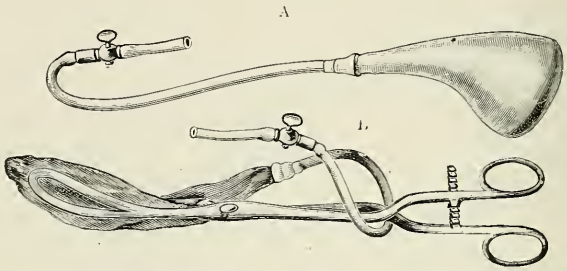


Fig. 580.—Champetier de Ribes' bag: A, inflated; B, folded for introduction into the uterus.

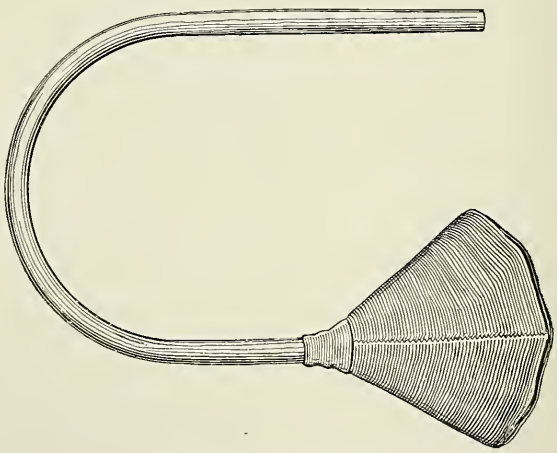


Fig. 581.—Voorhees' bag.

Manual Methods.—The best manual methods for the dilatation of the os are illustrated in figures 582, 588–593. In Harris' method the forefinger and thumb, and then the other fingers of the hand, are successively inserted, the thumb and the fingers being spread apart as widely as possible. In Edgar's method the dilatation is begun by branched dilators and is completed by the powerful action of the first two fingers of both hands. By this means very rapid dilatation of the os is possible; the manual method, therefore, is recommended in cases of greatest haste, in which it is only desired to secure enough dilatation to make the forcible extraction of the child possible.

Instrumental Dilatation.—*For the non-pregnant uterus* there are two- and four-branched dilators and the metranoikter of Schatz and the author. Two sizes of a two-branched dilator are required, a light and a strong. For the former, the Baer is recom-

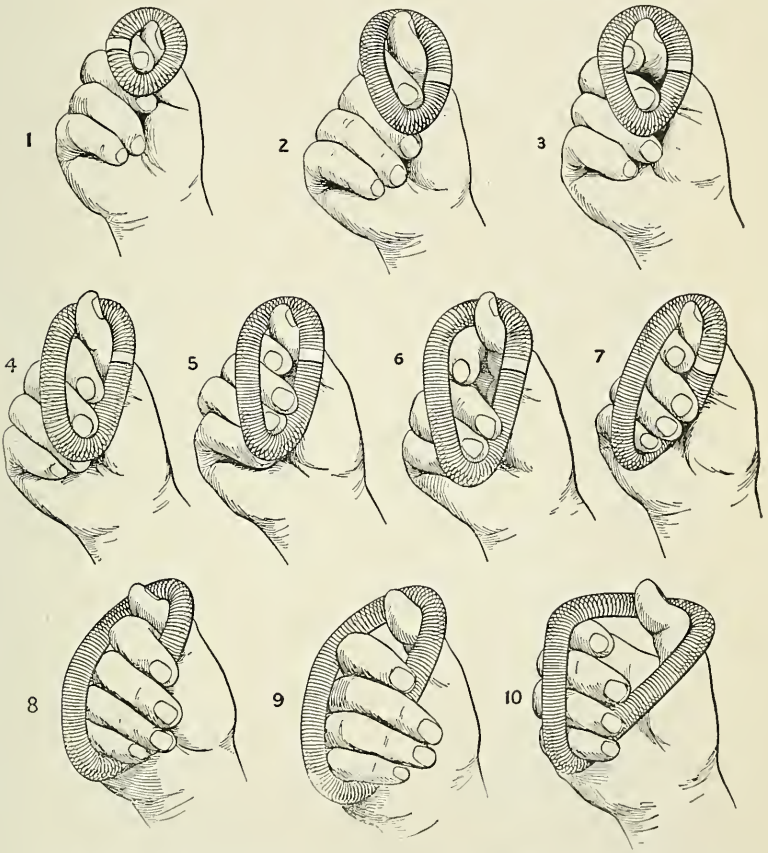


Fig. 582.—Method of performing rapid manual dilatation of the os uteri: 1, Position of fingers in the beginning of manual or digital dilatation of the cervix uteri, first position; 2, showing limit of dilatation in the first position; 3, second position; 4, showing limit of dilatation in the second position; 5, third position; 6, limit of dilatation in the third position; 7, fourth position; 8, limit of dilatation in the fourth position; 9, fifth position; 10, sixth position (Harris).

mended; for the latter, the Wathen's. As the four-branched principle is superior to the two, which only dilates in one direction, it is necessary to have a good four-branched dilator for a thorough dilatation of the cervix. The best is the Cleveland model (Fig. 583). Moreover, to effectively dilate the cervix the dilatation must con-

tinue a considerable time. To use dilators for twenty minutes, as is commonly done, is often useless, the cervix recontracting in a few hours. Hence, mechanical dilatation for dysmenorrhea and sterility has often been disappointing. Schatz devised a dilator (Fig. 585) for retention within the uterus for twenty-four hours which gives much more satisfactory results than the temporary dilatation usually

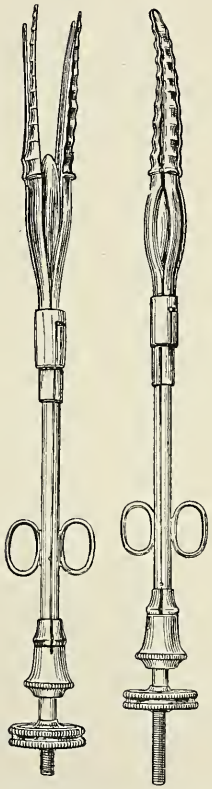


Fig. 583.—Cleveland's dilator.

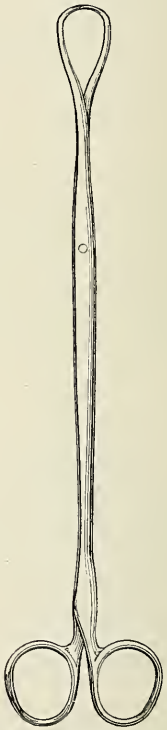


Fig. 584.—Author's double tenacula for the cervix.

employed, and the author has made the instrument more effective by converting it into a four-branched one. By thoroughly dilating the cervix with the dilators in ordinary use, including Cleveland's, by a curettage with Sims' and Martin's curettes, and by leaving, if possible, the four-branched metranoikter or, if not, the two-branched metranoikter in the uterus for twenty-four hours, the percentage of cures in mechanical dysmenorrhea and sterility can

be more than doubled.[1] Wylie has invented a "drain" to accomplish the same purpose, but it must remain in the uterine cavity some days, does not dilate the cervical canal so widely, and causes by its long retention an infection of the endometrium, which may

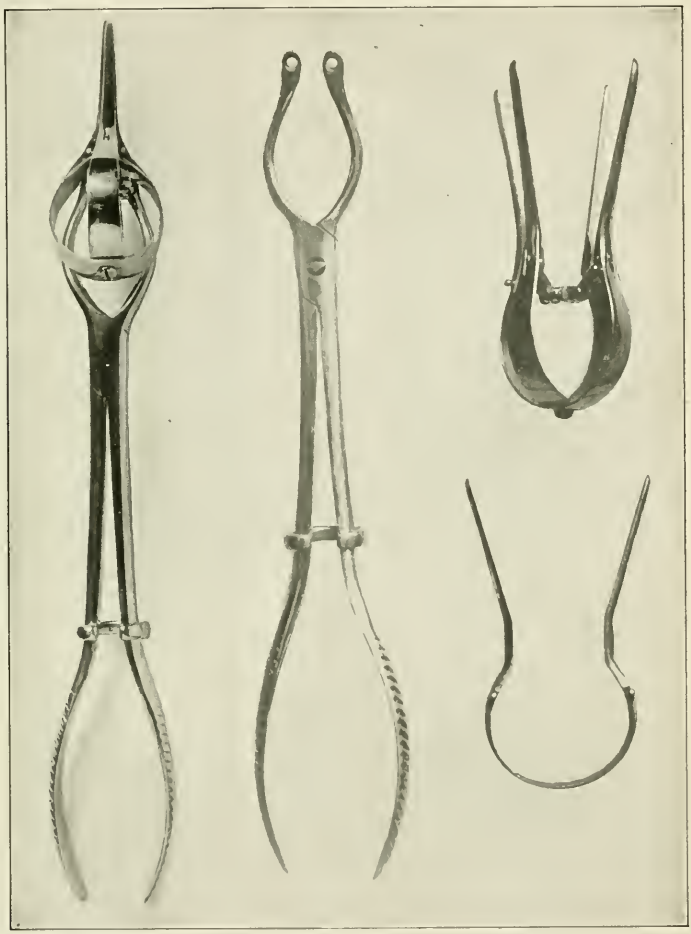


Fig. 585.—Schatz's metranoikter. The four-bladed instrument is the author's modification.

spread to the tubes. It is, therefore, not to be recommended. The technic of dilatation of the cervix is as follows: An Au-

[1] A virgin's vagina will not accommodate the four-branched dilator. I have used the metranoikter over four years in more than 150 cases, with the results stated in the text.

vard's speculum is inserted; the anterior lip of the cervix is seized with the author's double tenaculum and pulled down. The two-branched dilators, first the light, and then the strong, are inserted and separated to an inch and a quarter on the scale; the Cleveland dilator is next inserted and opened to 70 or 90 mm. (circumference) on the scale; the uterus is then curetted with a Sims' curette, all four walls being scraped several times in succes sion. A Martin's curette is next used to curette the fundus and

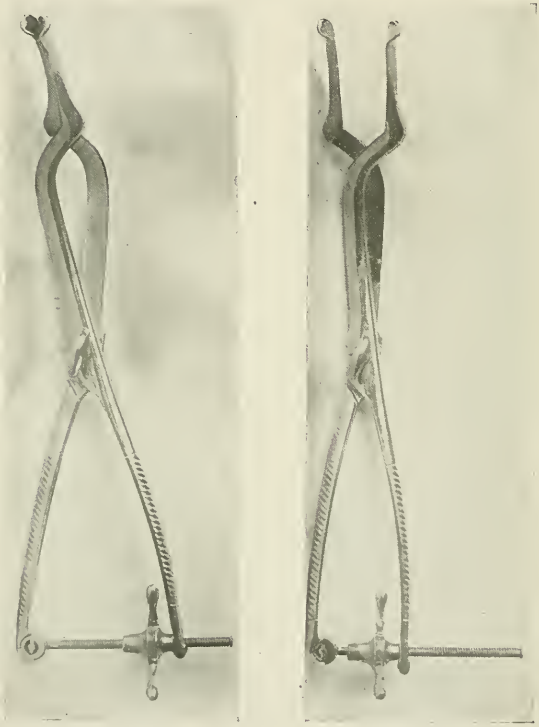


Fig. 586.—J. C. Hirst's dilator for the pregnant uterus (modified from Gau and Norris).

cornua. The uterus is washed out with a two-way catheter. The metranoikter is inserted, the vagina packed with gauze; 10 per cent. of the patients require morphin. The metranoikter is removed in twenty-four hours and the uterine cavity is again washed out with the Fritsch-Bozeman two-way catheter.

In the pregnant uterus, if the os is already about the size of a dollar, and it becomes necessary to deliver the child rapidly, forceps may be applied to the head and strong traction made. The cervix will either

stretch or tear, and it is thus possible to extract a child in a very few minutes when there is urgent need for rapid delivery. Several two- or more bladed instruments have been devised to dilate the cervix of a pregnant or parturient woman. The most generally useful one is the modified Gau dilator of J. C. Hirst (Fig. 586). Bossi's[1] dilator was first described in 1891 (Fig. 587), but was not generally

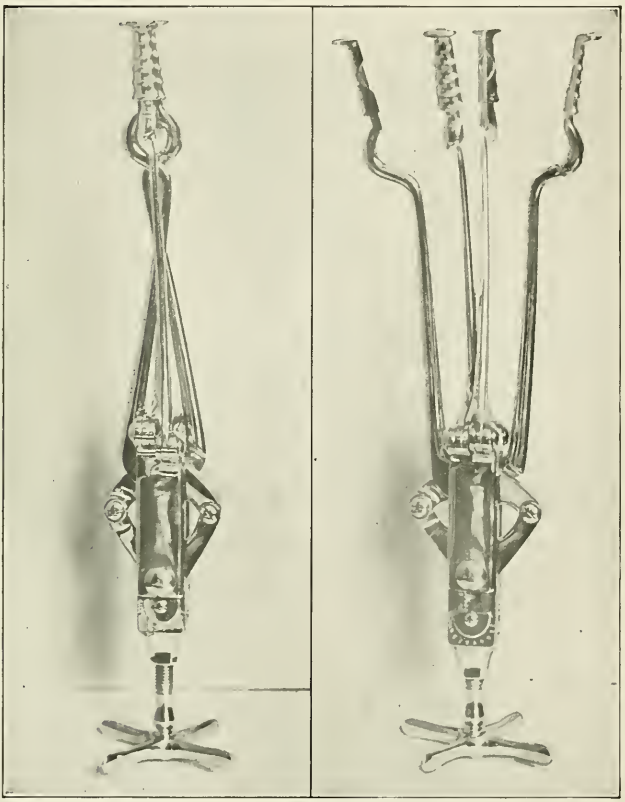


Fig. 587.—Bossi's dilator, closed and opened. The expanded tips are removable, so that the instrument may be inserted in an undilated os.

adopted till Leopold recommended it ten years later. It is a powerful instrument for the dilatation of the gravid or parturient cervix. If the blades are gradually dilated up to 5 or 6 cm. on the scale, there is little or no risk of injury. Rapid and complete dilatation with this powerful instrument is sure to be followed by extensive injury. It is best to dilate to 5 or 6 cm.; next to insert the largest

[1] "Sulla Dilatazione rapida della Bocca Uterina col Dilatore Bossi," "Clinica Obstetrica," Anno iv, fasc. vi–vii, 1902.

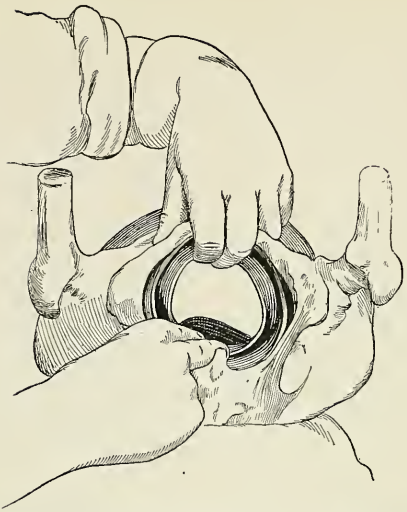


Fig. 588.—Bimanual dilatation of the parturient os. Os two-thirds dilated. Entire effacement of internal os (Edgar).

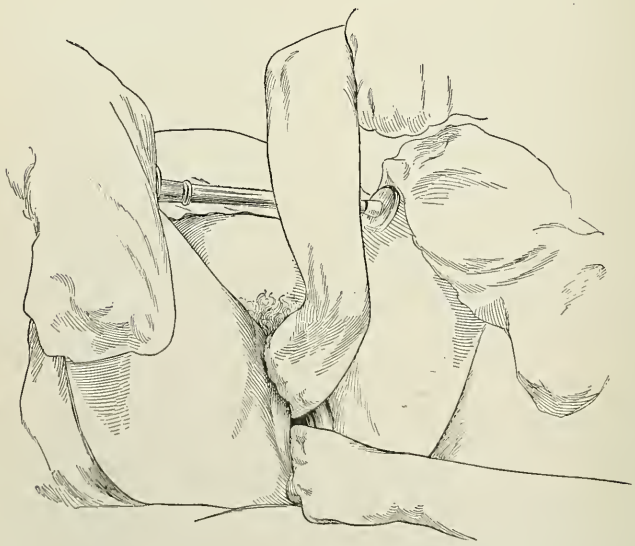


Fig. 589.—Bimanual dilatation of the parturient os. External view, showing position of hands (Edgar).

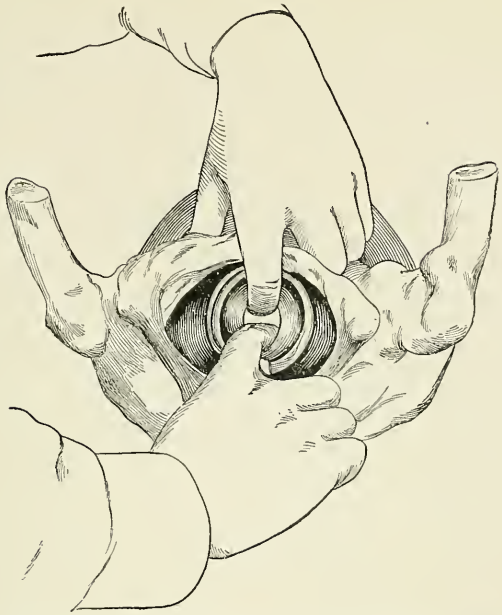


Fig. 590.—Bimanual dilatation of the parturient os. Os admits two fingers. Vaginal and supravaginal portions of the cervix present; commencing shortening of the cervical canal (Edgar).

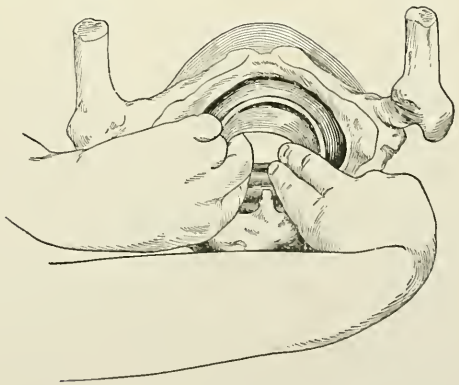


Fig. 591.—Bimanual dilatation of the parturient os. Os one-half dilated. Lateral position of the hands (Edgar).

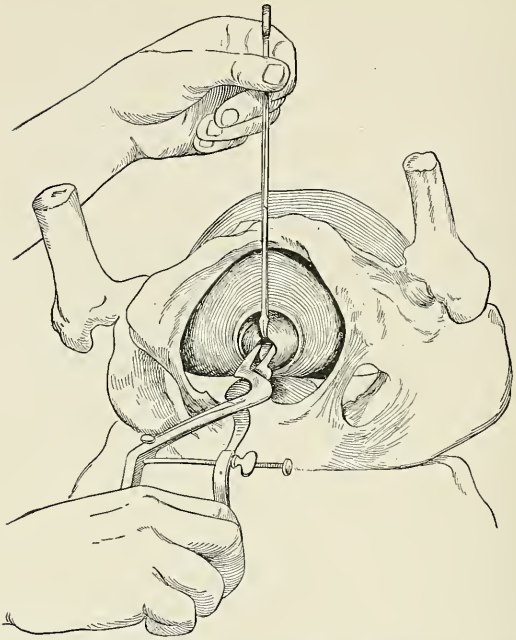


Fig. 592.—Instrumental dilatation of parturient os, preparatory to further manual dilatation (Edgar).

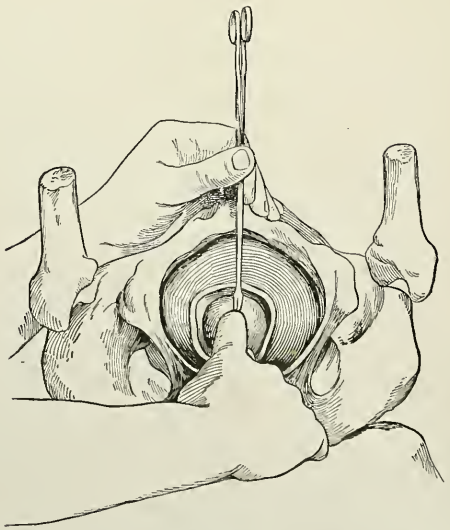


Fig. 593.—Digital dilatation of the parturient os. Os admits one finger. Vaginal and supravaginal portions of the cervix present (Edgar).

size Voorhees' bag; then to apply forceps or to perform version. The cervical canal may be dilated by inserting graduated bougies from the size of a small lead-pencil up to the size of one's wrist or forearm (Hegar). This is an effective method, but

Fig. 594.—Hegar's dilators or bougies.

it requires a number of bougies which are scarcely ever carried about by any obstetrician, and it is, therefore, only available in a well-equipped obstetrical hospital. In fifteen to twenty minutes by this plan, in a multipara, the os may be almost fully dilated, or sufficiently at least to permit the extraction of the child by forceps if the head presents, or by drawing down a leg in a breech presentation.

Incisions.—*In the non-pregnant uterus* the cervix may be separated from the vagina and bladder by a T-shaped incision in the anterior vaginal vault, and then cut in the median line beyond the internal os, thus permitting the insertion of the forefinger to explore the uterus or obtaining room to remove an intra-uterine growth, such as a myoma.

In the pregnant uterus, Dührssen introduced incisions through the cervix to the vaginal vault.[1] It is to be recommended if there is need for the utmost rapidity in the extraction of the child. If the head presents, it is best to apply forceps to pull it firmly down against the cervix, and then, with scissors or a blunt-pointed bistoury, to cut the cervix in one, two, or as many as four places, until the child can be dragged through the cervical canal. It is necessary afterward to suture the incisions, which bleed profusely for a time at least. If the patient's condition is serious, it may be sufficient to place one suture in the upper angle of each incision. This checks the hemorrhage sufficiently and promotes, occasionally, the entire repair of the injury.

Vaginal Cesarean Section or Anterior Vaginal Hysterotomy.—Dührssen elaborated his original plan of multiple deep incisions in the cervix by proposing the transverse incision of the anterior vaginal vault, a longitudinal section of the vagina, separating the bladder completely from the cervix and vagina, if necessary, opening the peritoneal cavity, pulling down the cervix by strong double tenacula, splitting the anterior lip and the lower uterine segment in the middle line till sufficient space is gained

1 "Wiener. Med. Presse," xxxi, 33.

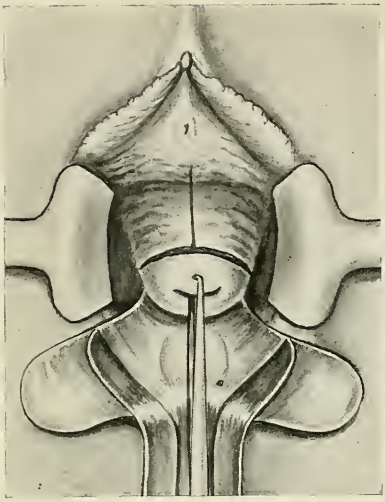


Fig. 595.—Vaginal incisions for vaginal Cæsarean section.

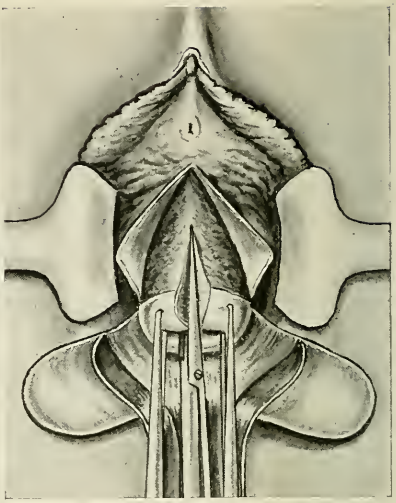


Fig. 596.—Cutting the cervix and, if necessary, the lower uterine segment with scissors in the median line, anteriorly, after stripping back the bladder.

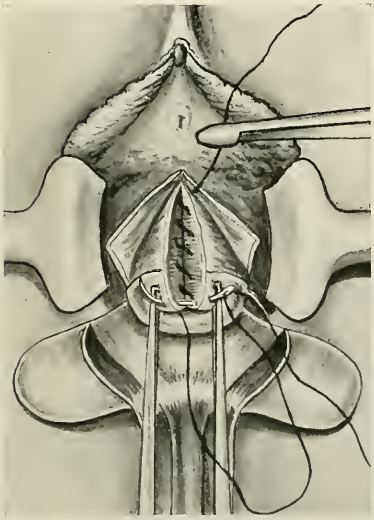


Fig. 597.—The two-tier suture of catgut to close the cervical wound.

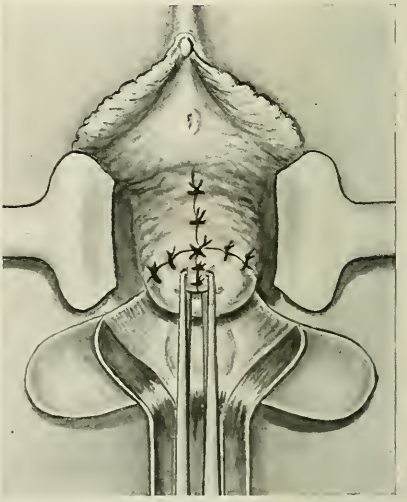


Fig. 598.—The vaginal wounds closed by interrupted sutures.

to deliver a full-term child. This is the quickest means of delivering a woman, and has, in selected cases, decided advantages. Dührssen enthusiastically recommends it as the first step in the treatment of eclampsia. The author has employed it, but would only recommend it if the quickest delivery possible is essential. Slower dilatation of the cervix by the hands, bags, or Bossi's dilators is safer and less troublesome, if there is no urgent necessity for immediate delivery. The wound in the lower uterine segment and cervix is sutured with a tier suture of durable catgut; the anterior vaginal vault is closed with interrupted sutures and gauze drainage is employed for four days or more. Hemorrhage during the operation is controlled by forcibly pulling down the cervix.[1]

If the patient is a primipara, it is necessary to precede the section of the vagina and cervix anteriorly by a Schuchard's section of the vagina posteriorly; that is, a deep incision in the left posterior vaginal sulcus and through the perineum.

INDUCTION OF ABORTION

By the induction of abortion is meant the interruption of pregnancy bejore the viability of the child—that is, prior to the sixth month of pregnancy.

Indications.—The induction of abortion should be undertaken as reluctantly as one would commit justifiable homicide. If, in the course of pregnancy, some disease arises as a direct consequence of gestation, or if a woman suffering from disease is made much worse by the existence of pregnancy, and if her life is distinctly endangered in consequence, it is not only justifiable, but it is the physician's duty to terminate gestation, and thus save one life, and that the more valuable of the two, instead of sacrificing both mother and fetus. The following conditions occasionally furnish a justifiable indication for the induction of abortion.

Pathological Vomiting.—When all the remedies for this condition have been conscientiously and carefully tried without avail, when rectal alimentation has been continued for a week or ten days without marked improvement in the woman's condition, and it is evident that she is in danger of death if her pregnancy continues, the induction of abortion for uncontrollable vomiting is justifiable.

Toxemia, Albuminuria, and Kidney Breakdown.—If ominous symptoms appear, such as progressive edema, persistent headache,

[1] Dührssen, "Zeitschr. f. Geb. u. Gyn.," Bd. xxiii; "Centralbl. f. Gyn.," No. 7, 1892; "Arch. f. Gyn.," Bd. xlii and xliii; "Berliner klin. Wochenschr.," No. 27, 1892; "Der Vaginale Kaiserschnitt," 1896; "Arch. f. Gyn.," Bd. lxi; "Eklampsie," in v. Winckel's "Handbuch," Bd. II³, 1905. *Ibid.*, Bd. III², 1906, in which Acconci's claim to priority is discussed.

steady or rapid increase in the amount of albumen, sudden diminution in the quantity of urine, casts in great number in the urine, and failing vision, in spite of careful dietetic and medicinal management, the induction of abortion is called for.

Death of the Embryo or Fetus.—If it can be demonstrated that the embryo or fetus is dead within the uterus, its removal is desirable; but it must be remembered that the signs of fetal death are difficult to elicit, and that a certain diagnosis can be made only after an observation extending over some days or weeks, unless the membranes are ruptured and the fetal body has begun to putrefy.

Certain Intra-uterine Diseases.—As pointed out in the section on Intra-uterine Diseases, acute hydramnios and cystic degeneration of the chorion villi may call for the induction of abortion.

Uterine Hemorrhage.—Uterine hemorrhage, from placenta prævia or from the detachment of an abnormally situated placenta, may be so profuse or so long continued as to demand the evacuation of the womb early in pregnancy.

Displacement of the Gravid Uterus.—Retroflexion, prolapse, and anteflexion of the gravid womb, resisting other treatment, and threatening to become incarcerated, may call for the termination of gestation.

Certain Nervous Diseases.—In the course of acute mania and melancholia, or in chorea, and possibly in general pruritis, the question of terminating pregnancy may be considered.

Certain Blood Diseases.—If pernicious anemia or leukocythemia arises in pregnancy or is made much worse by the advent of pregnancy, the question of terminating the woman's condition may be considered.

In any of these indications the question is an anxious one, and should not be decided by the attending physician on his own responsibility, no matter what his experience or skill may be. There should invariably be a consultation, so that the responsibility may be shared and the operator may be free from criticism.

Methods of Inducing Abortion.—Many plans have been advocated, but most of them have been found either too slow, too dangerous, or ineffectual. Such are the administration internally of ergot, rue, sabina, aloes, and of cotton-root; injections upon the cervix or between the membranes; the insertion of inflated rubber bags in the vagina or in the uterus; rapid or gradual dilatation of the cervix; perforation of the membranes; injections of irritating substances, as Monsell's solution, into the womb; and an electrical current.

The method employed by myself with satisfaction in a number of cases may be described as follows: The woman is anesthetized and placed in the dorsal position upon an operating table.

The vagina and vulva are disinfected. The anterior lip of the cervix is fixed with a double tenaculum, and the cervical canal is dilated cautiously with branched dilators (Baer's and Wathen's). An Emmet's curetment forceps is inserted into the womb, opened and shut in several directions so as to crush the ovum, and then withdrawn with whatever portion of the ovum or embryo that comes with it. It is impracticable to remove the whole ovum at once. Iodoform gauze is then packed in the lower uterine segment and in the cervical canal, and gauze is packed in the vagina. The gauze remains in place twenty-four hours. On its removal, if the remainder of the ovum is not yet discharged from the external os, the cervix, now much softened and easily stretched, is further dilated by branched dilators or by the fingers, and the uterine cavity is emptied of all its contents as after an ordinary abortion by the curet, the finger, and a placental forceps (Emmet's curetment forceps). If, for any reason, as in the exhaustion of hyperemesis, the administration of an anesthetic is undesirable, the dilatation of the cervix may be made almost painless by the injection into the cervix at four different points of Barker's fluid, β-eucain, adrenalin chlorid, and normal salt solution.

While the interruption of pregnancy before the sixth month is called the induction of abortion, the method just described is only practicable up to the fourth month. After that time abortion is induced in the same manner as premature labor.

INDUCTION OF PREMATURE LABOR.

In addition to the indications for the induction of abortion there are special indications for the premature interruption of pregnancy after the child has become viable. The most important of these is a contracted pelvis. The next in importance, perhaps, is placenta prævia. It may be necessary, in advanced phthisis or in grave heart disease, to secure the mother's delivery before term, in order that the child may be born before the fatal termination of her disease, which is evidently close at hand, or to save her the strain of the last month of pregnancy and to insure her an easy labor. Labor at term, or shortly after, may be induced in a woman showing a disposition to prolongation of pregnancy. Last of all, in the rare cases of habitual death of the fetus just before term, it is advisable to induce labor before the period at which the child's death may be expected.

Methods of Inducing Labor.—Krause's[1] method is the easiest for the general practitioner without special training in gynecological

[1] "Die künstliche Frühgeburt, monographisch dargestellt," von Albert Krause, Breslau, 1855.

manœuvers. An aseptic, stiff, silk or linen bougie (No. 17 French), which has been soaked for at least one-half hour in a cold corrosive sublimate solution (1: 1000), is anointed with sterile glycerin. The patient is placed in the dorsal position. The operator passes two fingers of his left hand into the vagina, inserting one or, if possible, both finger-tips into the cervical canal, which dilate the cervix and are swept around the lower uterine segment to sever the attachment of the membranes. The bougie is then passed along the groove between the two fingers until it enters the cervical canal and passes into the lower uterine segment. It is pushed further in until it has entirely disappeared within the uterus, with the exception of an inch or a little more that protrudes from the external os. An iodoform gauze tampon is packed lightly in the vagina to keep the bougie in place. Active and effective labor-pains may begin in from thirty minutes to thirty-six hours. In the majority of cases labor begins within twelve hours. If it has not begun at the end of that time, a second bougie should be inserted alongside the first. If, after twenty-four hours more, labor has not yet begun, the cervix should be artificially dilated with Voorhees' bags or Bossi's dilators, and, if necessary, the membranes should be ruptured, forceps may be applied to the head, or version may be performed, and the child extracted by the feet.

In about one-fifth of the cases the bougie method fails to excite labor-pains. The following plan is the most certain and efficient: Dilatation of the cervical canal to a diameter of about 7 cm. with the modified Gau dilator; the insertion of one or two bougies and also of a Voorhees bag (medium or large size).

If the mother's condition demands immediate delivery, the following methods are available (accouchement forcé): The cervical canal is dilated forcibly by the hand or by Bossi's dilator, the membranes are ruptured, a forceps is applied, or version is performed and the child is extracted by the feet; vaginal Cæsarean section; the use of Pomeroy's bag for ten to fifteen minutes and then the forcible extraction of the child by forceps or version.

FORCEPS

Historical.—Three years before the massacre of St. Bartholomew, in 1569, William Chamberlen, a Huguenot physician, fled from France to England. He settled in Southampton and raised a large family of children, two of whom, both named Peter, became prominent physicians in London. The younger Peter was in continual conflict, however, with his brother practitioners, and was several times summoned for reprimand and punishment before the College of Physicians. On one of these occasions he was

accused of boasting that "he and his brother and none others excelled in these subjects" (difficult labors). This was in the beginning of the seventeenth century (1616), and is the first record of the secret which remained in the Chamberlen family for more than three generations, which was the foundation of their boast that they alone could be regarded as skilled obstetricians, and which enabled them all to grow rich by the practice of their hidden method of dealing with difficult labors. But instead of being honored as the discoverers of one of the most important inventions of medicine, posterity has condemned them for depriving the world of knowledge that might have saved thousands of lives and have prevented untold suffering during a hundred years.

The younger Dr. Peter Chamberlen had a son, also named Peter, who was a remarkable character: a man of great, but ill-directed talents; possessing some inventive genius; an extensive traveler; an accomplished linguist; obtaining the favor and friendship of the British royal family, and engaged during the greater part of his mature life in a lucrative practice among the upper classes in London. It is to this man, who made such a mark in his time, that the invention of the forceps was formerly credited; but there is no doubt, from evidence recently come to light, that he inherited the secret from his father, who, in his turn, obtained it from his elder brother, Peter Chamberlen, senior.[1] The idea that the younger Peter invented the instrument was no doubt fostered by himself, for he was a man of intense egotism. A short time before his death he wrote his own epitaph, which began—

> "To tell his learning and his life to men
> Enough is said by, 'here lies Chamberlen.'"

This Peter had a son, Hugh,[2] who also studied medicine, and to whom his father disclosed the family secret of the Chamberlens. Hugh, who was extravagant, determined to make the most of his inheritance, and to part for a consideration with the secret that had remained in his family so long. He accordingly went to Paris and offered to acquaint Mauriceau with his secret method of dealing with difficult head presentations, which up to that time had been managed by tearing the child to pieces with sharp hooks. For the disclosure of his secret Chamberlen asked the enormous sum—in those days—of ten thousand dollars (écus). Mauriceau took the matter under consideration,

[1] "The Chamberlens," J. H. Aveling, London, 1882.

[2] The Hugh Chamberlen whose bust may be seen in Westminster Abbey is the son of this Hugh. He was a man of higher character and much greater repute than his father.

and, happening to have a deformed dwarf in labor, Chamberlen was asked to test his method in the case. He did so and failed completely, the patient dying from a ruptured uterus, undelivered. This ended the negotiation for the sale of the secret in Paris. On his return to England Chamberlen translated and published Mauriceau's book, with a preface written by himself, in which he says: "My Father, Brothers, and my Self (tho none else in Europe as I know) have by God's Blessing and our Industry, attained to, and long practised a way to deliver Women in this case without any Prejudice to them or their Infants." Hugh Chamberlen is next heard of in Amsterdam, whither he had fled from England on account of some financial difficulties. Here he had better fortune than in Paris, managing to sell his secret to the College of Physicians of Amsterdam. This institution immediately induced the government to pass a law which forbade any one to practise medicine in the town who had not given satisfactory evidence of possessing the secret now owned by the college, and imparted to each aspirant for a medical degree who was able to pay for it. The traffic in the Chamberlen secret continued until the middle of the eighteenth century, when two public-spirited citizens of Amsterdam, thinking it an outrage that a method for which such extravagant claims were made should remain a secret, took a course in medicine, purchased the knowledge required of them from the College of Physicians, and published it to the world. It was a single blade of the obstetric forceps! Whether Chamberlen tricked the college or the college cheated its students is not known.[1]

Fig. 599.—Smellie's straight forceps. An eighteenth century English forceps, the blades wrapped with leather, to keep them from slipping.

Before this time, however, certainly as early as 1725, the true secret had leaked out in England, and during the middle of the eighteenth century the forceps came to be widely known and quite generally used. There was for a long time much

[1] Other stories are that Roonhuysen sold the secret to Ruysch and a number of others; that a student of Roonhuysen's made a surreptitious drawing of the instrument and published it; that Jacob de Vischer and Hugo van der Poll obtained the secret from the daughter of a former possessor.

speculation as to the kind of instrument that the Chamberlens really invented, and there were many, some years ago,

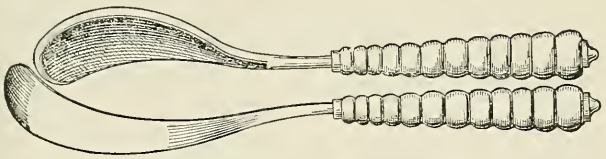


Fig. 600.—Palfyn's forceps or "hands."

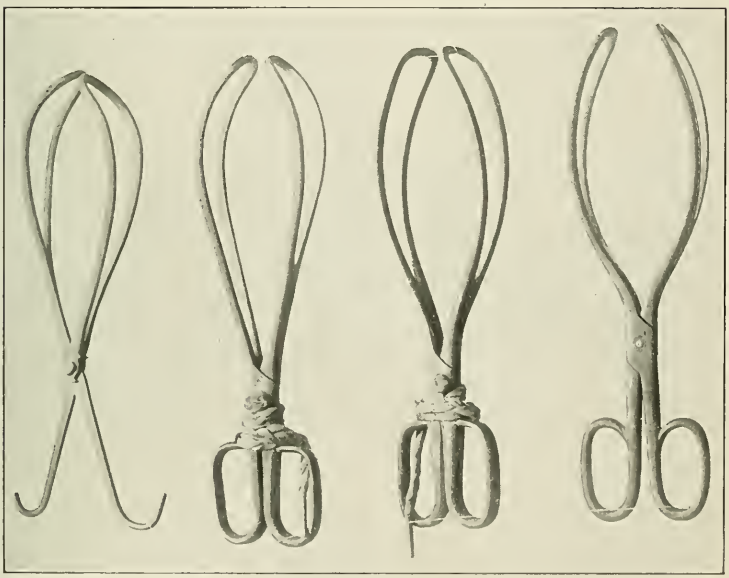


Fig. 601.—The four forceps found in the Chamberlen chest.

Fig. 602.—Chamberlen's vectis.

who doubted that the invention had been the forceps at all. It was thought at one time to have been a forcing powder or a blunt hook. It was believed for a while that Jean Palfyn (1716) had

first conceived the idea of an instrument which was developed later by others into the forceps. But these doubts have been set at rest. At Woodham, Mortimer Hall, in Essex, owned and occupied by Peter Chamberlen, junior, was discovered, in 1813, a chest in which were found the instruments shown in figure 601. It is obvious that the successive possessors of these instruments received all that were in existence in order to preserve the secret. The evolution of the forceps at the hands of the original inventor or of his descendants is plainly seen in the illustrations. The Chamberlens were also the inventors of the vectis, or lever, an instrument no longer made, for a single blade of the obstetric forceps answers the purpose perfectly.

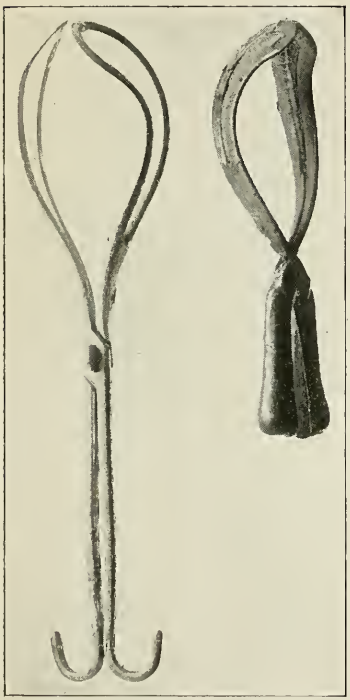


Fig. 603.—A, Levret's forceps with a pelvic curve; B, Smellie's forceps with a pelvic curve.

The Chamberlen instrument had not been long known and employed before certain defects in it were noticed. It was found difficult to introduce it, especially if the head was high up in the parturient tract. It was also found difficult to lock it, and the necessity of binding the handles together was found to be inconvenient.

The first of these disadvantages, the difficulty of introduction, was soon discovered to be dependent upon the curve of the pelvic canal, and it was recognized that an instrument to be introduced into this curved canal should itself be curved to correspond with the direction of the canal. Almost simultaneously, in England and France, about 1750,[1] a pelvic curve was added to the forceps—in England by Smellie, in France by Levret. Each of these men, distinguished obstetricians of their time, added other important modifications to the forceps, which are worthy of careful attention, for the two

[1] Levret presented his forceps to the Academy of Surgery in 1747. Smellie first published a description of his in 1751, though he had invented the pelvic curve ten years before.

instruments known as the forceps of Levret and the forceps of Smellie are the direct progenitors of the two types of forceps in use at the present time. The English forceps, as may be seen in figure 603, B, is small, short, and light. It has, as may be seen, the English lock ; the pelvic curve is inadequate, and to keep the instrument from slipping it was originally wrapped in leather ; but the instrument had good points about it, which are found modified in the modern English forceps of Simpson.

The French forceps (Fig. 603, A) is a heavy, long instrument, with powerful handles and closely approximated blades. The lock is the pin or French lock, which the French forceps carry at the present time. In this instrument, too, the pelvic curve is inadequate, but the forceps has certain advantages, which, modified, may be found in many modern instruments. It was not long before the disadvantage of the inadequate pelvic curve was

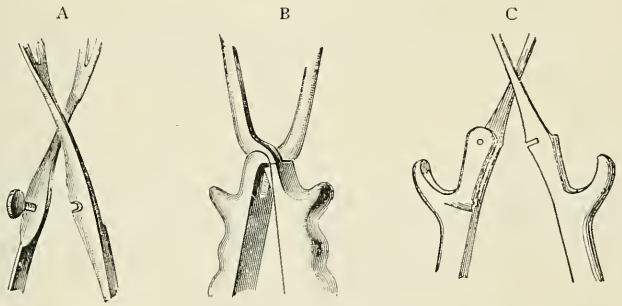


Fig. 604.—A, French, B, English, C, German locks.

appreciated, and soon after the time of Smellie and Levret this feature was improved, and a forceps with a better constructed pelvic curve came into use. It may be noticed that the handles of both the Levret and the Smellie forceps are rather difficult to grasp, if one desires to make a strong traction upon them. This disadvantage was overcome by Busch, a German, who was the first to add the cross-pieces or shoulders to the handles, which enable the operator to take a firm and convenient grip of the instrument.

It is plain that both the French and English locks each possess some advantages and some disadvantages. The English lock is easy of adjustment, but is not very secure. The French lock is difficult to adjust, but when once fastened, is firm and unyielding. Brünnighausen united the advantages of both these locks and did away with their disadvantages in the lock known as that of Brünnighausen, or the German lock (see Fig. 604).

Almost every eminent obstetrician of the last century added some modification of slight importance to the forceps to which he attached his name; so that the patterns, differing in a slight degree from one another, have been almost innumerable. There are two types of modern forceps, however, that merit description—that of Hodge, in this country, and that of Simpson, in

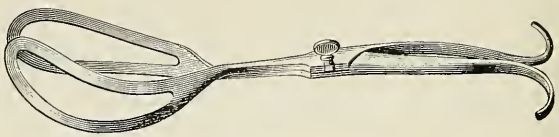


Fig. 605.—Hodge's forceps.

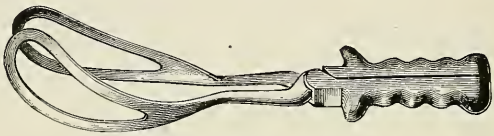


Fig. 606.—Simpson's forceps.

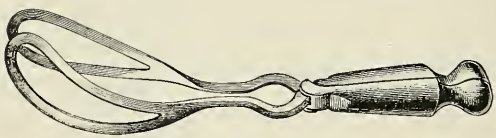


Fig. 607.—Davis' forceps.

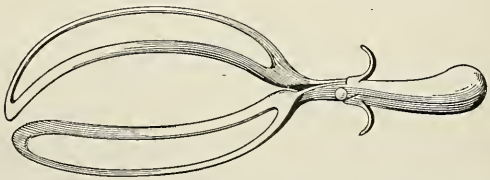


Fig. 608.—Small forceps, modified by the author for use at the vulvar orifice and pelvic outlet.

Edinburgh. They embody the best features of the two distinct classes that they represent. Hodge's forceps is the direct descendant of Levret's; Simpson's, of Smellie's. The Hodge forceps has the advantage of taking an extremely firm grip upon the child's head, and of allowing great power in extraction and compression of the head. Its great disadvantage is that it may

injure the child's head more easily than almost any other instrument. Simpson's forceps—the best modern instrument for ordinary use—has a cephalic curve so well constructed that it can scarcely injure the child's head, even when great force is used in extraction. The pelvic curve is sufficient, but is not so great as to embarrass the operator when the instrument is applied to

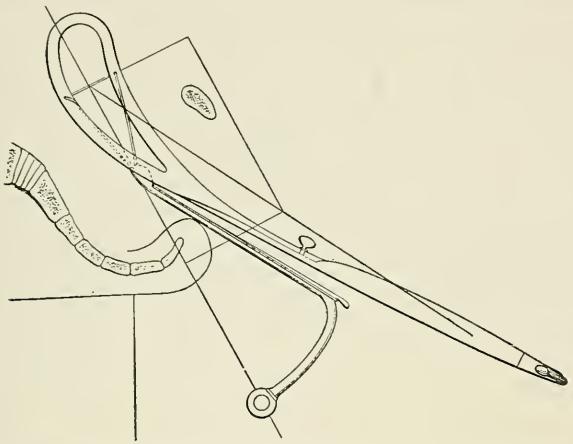


Fig. 609.—Showing the direction in which traction must be made by the handles, and the correspondence of the direction in traction upon the traction-handle and the direction in which the head must move.

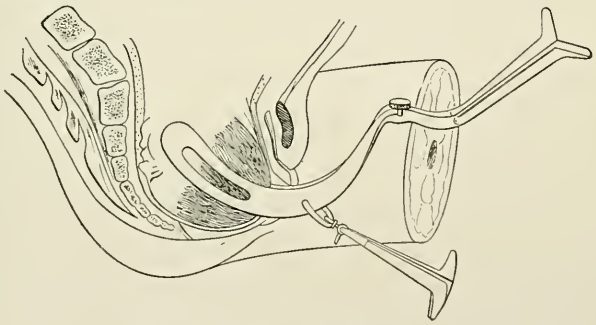


Fig. 610.—Hermann's forceps.

the head low down in the pelvic cavity. The blades are of such length that the instrument may be used with equal convenience at the superior strait or at the pelvic outlet. The lock is the English lock, which has the great advantage of easy adjustment; and the handles are provided with shoulders for two fingers, and with depressions along the handle for the remaining fingers and

thumb of the hand, so that a firm and convenient grasp can be taken of the instrument.

Another modern instrument deserving description is the Davis forceps, carefully constructed upon iron models of the fetal head. If this instrument is adjusted to the sides of the normal child's head in the pelvis, it is no doubt provided with a better cephalic curve than any other forceps; but if it should not be applied accu-

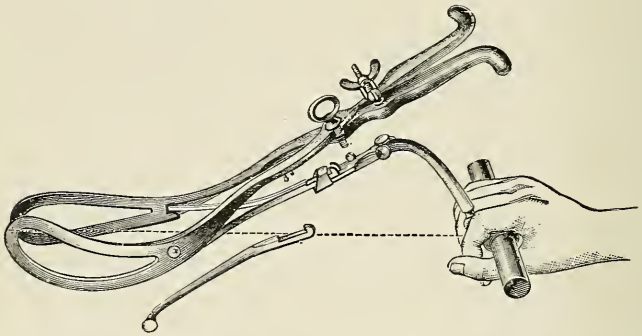


Fig. 611.—Tarnier's axis-traction forceps. To show the details, the hand is represented in an improper position for traction; below is one of the traction rods.

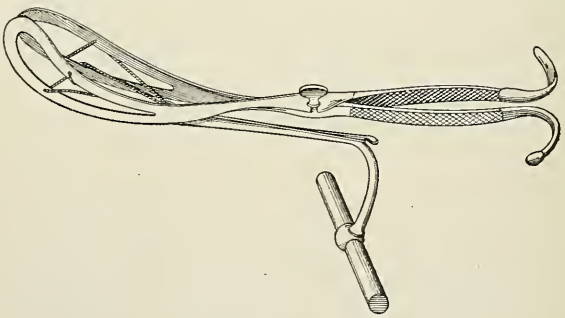


Fig. 612.—Poulet's forceps.

rately to the sides of the head, it is capable of doing the child's head great damage.

A useful instrument in the author's experience is a light, short forceps for use at the parturient outlet (Fig. 608).

As the mechanism of labor was better appreciated, and the forceps came into more general use in the latter part of the nineteenth century, it was realized that a certain amount of force was lost in the extraction of the child's head by the necessity of pulling the forceps in great part in the line of their handles. The angle at which this force met the direction it is desired to impose

upon the head is shown in figure 609. This difficulty has been overcome by the axis-traction principle, first proposed and carried out by Hermann, but popularized a generation later by Tarnier, of Paris. Figure 611 shows the best axis-traction forceps.[1] Figure 609 illustrates the coincidence of the line of traction with the direction in which the head must move. Many modifications of the axis-traction forceps have been made. None of them are commendable that do not allow the oblique application of the blades while traction is made backward in the median line. The cheapest and simplest is Poulet's, with strong tapes passed through eyelets in the forceps blades, and fastened to a handle bent at right angles. The best is Tarnier's latest instrument.

Uses and Functions of the Forceps.—The main function of the forceps is that of a tractor, which is by far the most important. Another function sometimes to be remembered is that of a rotator, as, for example, when a straight forceps is applied to the head in face presentation, with the idea of twisting the chin forward. In a difficult forceps operation the instrument sometimes has the function of a lever; the operator, swaying his arms a little from side to side, pulls down first one side of the head and then the other, in this way dislodging it from its impacted position. Last of all, least frequently to be employed, and most dangerous of all functions, the forceps may occasionally be regarded as a compressor; but the instrument is to be used for this purpose only in cases where there is a choice between compressing the head with the forceps and performing craniotomy, by the former action extracting a child that is almost certainly dead, or with a brain injury that makes death preferable, but with one or two chances for life out of a hundred.

Indications for the Application of the Forceps.—The forceps is an instrument designed mainly to reinforce the *vis a tergo* in labor. The most important indication for the use of the instrument is found in actual and relative uterine or abdominal inertia. The expulsive force may be relatively too weak if the resistance is greater than normal; hence the forceps is indicated in contracted pelves, rigidity of the soft parts, and overgrowth of the fetal body.

It may be necessary, in any case of head presentation in labor, hastily to terminate the process. This is especially desirable if conditions exist threatening the child's safety, as premature detachment of the placenta, compression or prolapse of the cord, prolonged pressure on the fetal head, feebleness and slow action

[1] Tarnier is said to have destroyed ninety-nine models before he accepted the one-hundredth as entirely satisfactory; for the description of his first models see Tarnier, "Description de deux nouveaux forceps," Paris, 1877; and "Gaz. des hôp.," Paris, 1877.

of the fetal heart, or sudden danger to the mother during the second stage of labor, as in eclampsia or acute dilatation of the heart.

There is a valuable indication of fetal condition during labor in the action of the fetal heart. In case of serious disturbance the heart-sounds first increase in rapidity, but soon become slower. If they sink to 100 and remain at that rate for any length of time, it is likely that the child will be born dead. It is a good practical rule in obstetrics, therefore, to apply the forceps and to deliver the child rapidly whenever the fetal heart-sounds sink to 100 and remain at that rate for a minute.

It may be desirable to save the mother the muscular exertion necessary in the second stage of labor, especially if labor is complicated by some adynamic disease, as phthisis, typhoid fever, or pneumonia. It is most desirable to avoid all muscular effort in the second stage of labor in valvular disease of the heart.

Finally, labor may be obstructed by abnormal positions of the cephalic extremity, or by anomalies in the mechanism of labor, as, for example, in face presentations when the chin does not rotate forward, or in vertex presentations when the head is insufficiently or excessively flexed.

A good rule of thumb to govern the obstetrical practitioner is to apply the forceps in head presentations whenever the presenting part remains stationary for two hours in the second stage of labor.

It is quite as important to recognize the contraindications to the use of the forceps as it is to understand when the instrument is needed. The contraindications to the use of the forceps, expressed dogmatically as rules of practice, are as follows:

The forceps must not be applied unless the os is dilated. There are exceptions to this rule. When the maternal or fetal life is threatened, it may be permissible to apply forceps through a partially dilated os, as, for example, when rupture of the uterus is threatened. It may be necessary, in some cases of rigid cervix, to dilate the os artificially by applying forceps and pulling the head down upon the cervix. It is also necessary, in cases of valvular disease of the heart and in the adynamic fevers, to shorten labor as much as possible by applying forceps to the head through an undilated os and rapidly extracting the child.

The forceps must not be applied until the head is engaged in the superior strait. This rule, too, admits of some exceptions. It is rarely possible to fix the head in a contracted pelvis with forceps, when the powers of nature are insufficient to attain this end. It is also justifiable to apply the forceps to the head loose above the superior strait in cases of placenta prævia with the head presenting, and to bring it down as a tampon in the pelvic canal.

The forceps must not be applied until the membranes have been ruptured. This rule admits of no exception.

The forceps must not be used as tractors in impossible positions and presentations, as, for example, face presentations with the chin posterior.

The forceps must not be employed unless the head be of average size. If the fetal head is too large or too small, the instrument is apt to slip and to inflict dangerous injuries upon the maternal soft parts.

The forceps must not be used when the disproportion between the head and the pelvic canal is too great.

In selecting an instrument, the author would recommend the beginner, if he must restrict himself to a single forceps, to purchase Simpson's. As soon as practicable, the Tarnier axis-traction forceps should be added, and it is a great advantage to possess, in addition to these two instruments, a light short forceps for use at the pelvic outlet.

Preparation for the Operation.—The patient's consent, or the consent of her husband or nearest relative, should always be first secured. An anesthetic renders the operation less difficult, and is to be recommended to beginners ; but if it is possible to deliver the woman in a short time,—say, half an hour or under, —and if the difficulty of extraction promises to be slight, the anesthetic may be dispensed with.

The woman should be placed in the dorsal position, if possible, upon a table or, if not, across the bed, her legs supported by assistants or held by an improvised leg-holder made of a twisted sheet. With the small forceps used at the pelvic outlet the lateral position need not be altered. The forceps should be boiled in a suitable instrument tray. Just before its insertion the whole blade, both outer and inner surfaces, should be smeared with carbolated vaselin or sterile glycerin.

The Application of the Forceps.—In using the Simpson forceps, or any other with a non-detachable pin-lock, the left-hand blade is always inserted first. The left blade lies upon the left-hand side of the woman's pelvis, and is held in the left hand of the operator. The right-hand blade of the forceps lies upon the right-hand side of the pelvis when introduced in position on the child's head, and is held in the right hand of the operator. Assuming that the diagnosis of the presentation and of the position of the presenting part has been made, and that the vagina is rendered surgically clean, the successive steps in the application of the forceps-blades may be summarized as follows :

Having introduced two fingers of the right hand into the

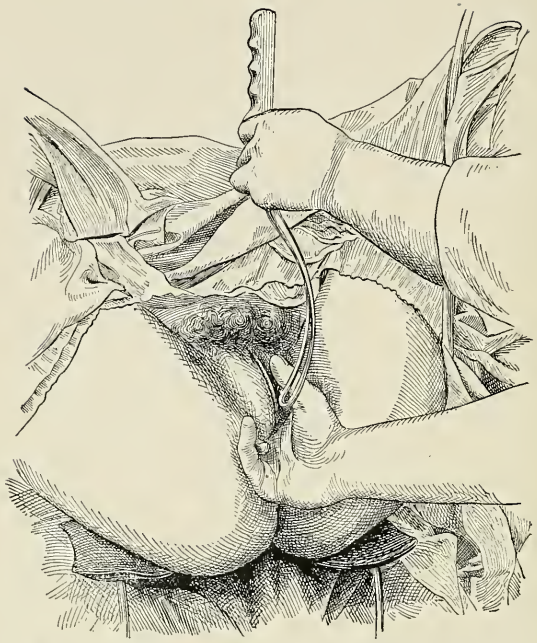


Fig. 613.—Introduction of the left blade: first step.

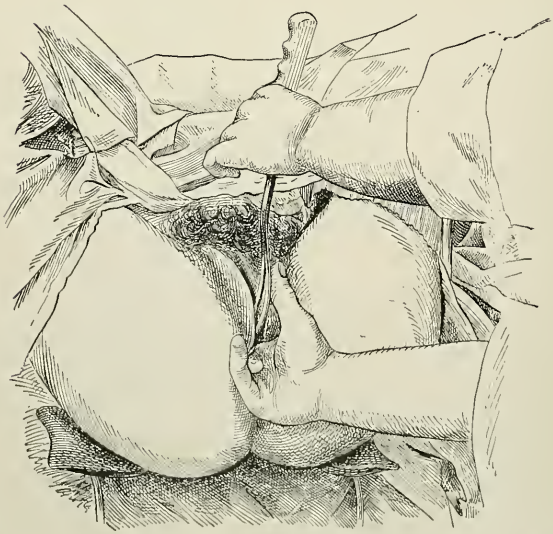


Fig. 614.—Introduction of the left blade: rotation on its long axis.

Fig. 615.—Insertion of the right blade, the left wrist being depressed to crowd the handle of the left blade out of the way.

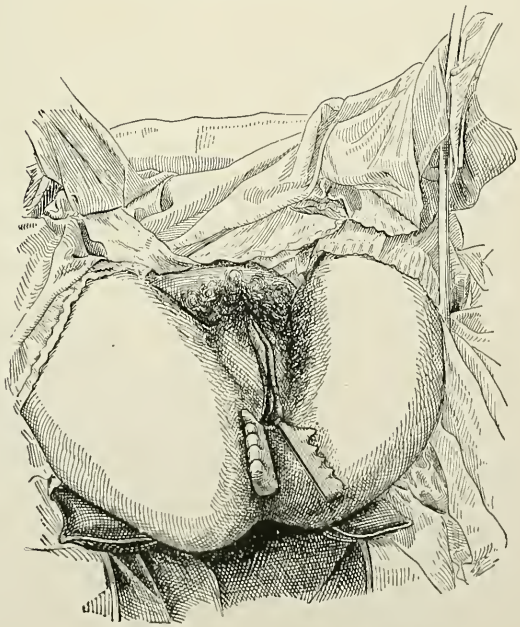


Fig. 616.—Both blades inserted, unrotated.

Fig. 617.—Rotation of a blade (the left).

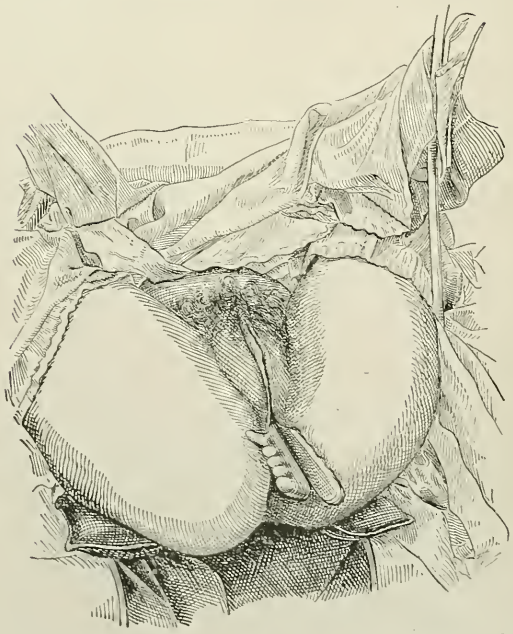


Fig. 618.—Both blades joined by the lock after the rotation of the right.

Fig. 619.—The grip on the forceps.

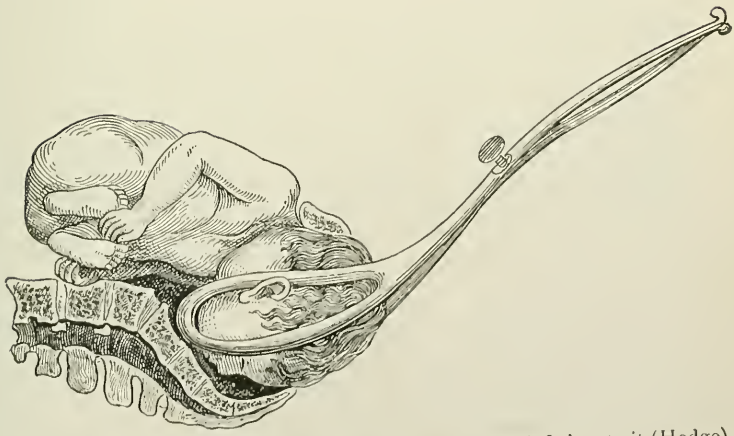


Fig. 620.—The direction of the forceps-handles at the inferior strait (Hodge).

vagina, the left blade, grasped at the lock by the left hand as a pen, is held perpendicularly to the woman's body, with the tip of the blade opposite the vulva. The tip of the blade is inserted in the vagina, and is pressed backward along the pelvic floor toward the sacrum. The blade is then rotated outward on its long axis to bring it in apposition with the posterior inclined plane of the pelvis, and to escape the promontory of the sacrum: the handle is depressed and the tip of the blade is thus elevated into the uterine cavity, the fingers of the right hand in the vagina guiding the blade and protecting the soft parts; finally, the handle is carried to the left side in order to engage the tip of the blade over the curve of the child's head. The right-hand blade is introduced in a similar manner, substituting the right for the left,

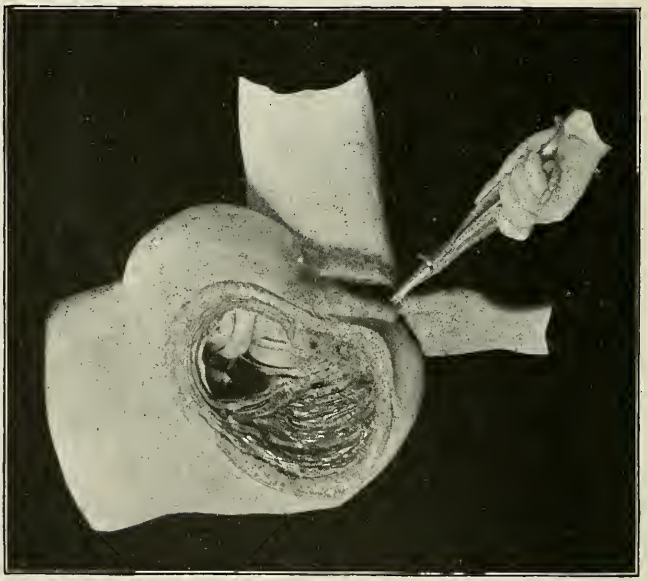


Fig. 621.—The direction of the forceps-handles with the head at the superior strait.

of course, in the foregoing description. As the blades lie after their insertion it is impossible to lock them, for both of them have ascended the posterior inclined plane of the pelvis, after being rotated outward on their long axes. It is necessary to bring one of them forward toward the region of the acetabulum, if the head lies in the oblique position, before the blades will lock.

Obviously, the blade to be rotated forward within the pelvis differs with the different positions of the presenting part. In the left occipito-anterior position of a vertex presentation the right-hand blade must be rotated forward, the left-hand blade lying as it was when first introduced. To rotate the right blade the handle is lightly supported by the fingers of the right hand, while the first two fingers of the left hand are inserted under and to the outer side of the heel of the blade and gently pry it upward, outward, and then inward. If the operator finds it more convenient, he may reverse the hands. If there is difficulty in locking the blades, a depression of both handles toward the perineum often facilitates their conjunction.

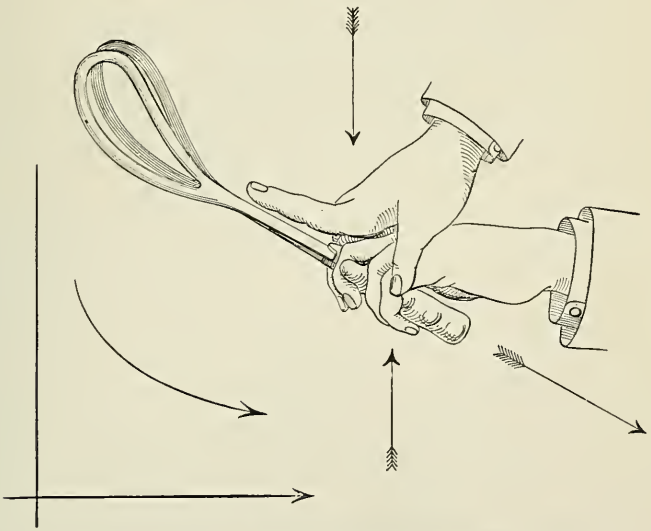


Fig. 622.—The grip on the forceps and the direction of traction.

The handles being approximated and the blades joined, the operator takes the grip upon the instrument shown in figure 622. The forefinger of the right hand is kept extended against the child's scalp to detect the first inclination on the part of the instrument to slip. Too great compression of the child's head may be avoided by placing a folded towel between the handles, and by using the slack of this towel to cover the shoulders of the forceps-handles, the operator saves his fingers from excessive fatigue and even bruising. The grip represented in figure 622, with pressure exerted downward, outward, and on the ends of the handles upward, enables the operator to impose upon

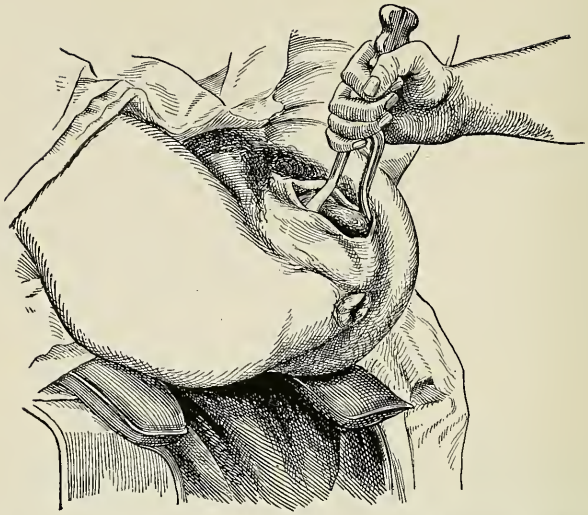


Fig. 623.—The extraction of the head from the vulvar orifice: first stage.

Fig. 624.—The extraction of the head from the vulvar orifice: second stage.

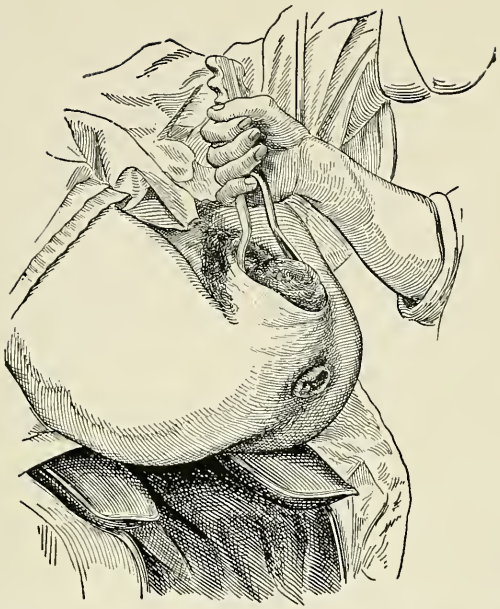


Fig. 625.—The extraction of the head from the vulvar orifice: third stage.

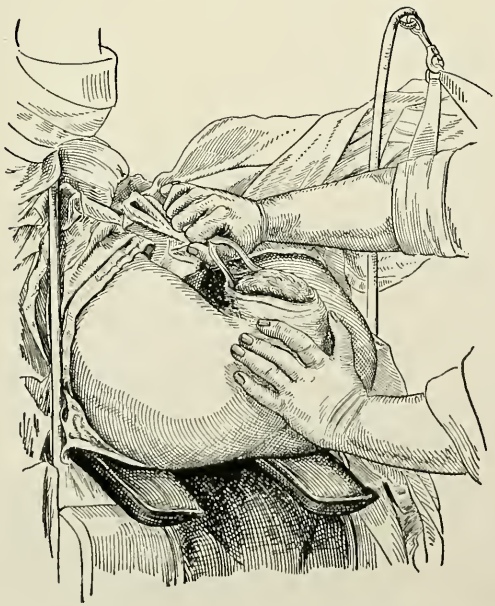


Fig. 626.—The extraction of the head from the vulvar orifice: fourth stage.

the head a movement corresponding with the axis of the parturient canal. If traction were made directly outward by pulling straight upon the forceps-handles, much of the force would be lost by dragging the head against the symphysis pubis.

In making traction, nature should be imitated as closely as possible, the intervals between one's efforts corresponding to the usual intervals between the pains, and the traction lasting for about a minute. In the intervals of rest the blades should be loosened, or even unlocked, to spare the fetal head from long-continued and uninterrupted compression. The force should be exerted by the muscles of the shoulders and arms. It is inadvisable to throw the weight of the trunk upon the forceps and it is absolutely inexcusable to utilize the muscles of the back and legs, plus the weight of the body, by bracing the feet while pulling upon the forceps. The tractive force should take a different direction as the head progresses along the parturient tract. When the forceps is at rest, the direction of the handles is a good indication of the direction in which the next traction should be made; as the head descends the birth-canal and appears at the vulvar orifice, distending the perineum, care should be exercised to moderate the tractive force, otherwise the head might be violently pulled out through, instead of over, the perineum. When the degree of distention shown in figure 623 is reached, the grip of the forceps is changed. The handles are seized in the right hand, as shown in figure 623, the operator standing to one side of the patient. Instead, now, of making traction, the forceps-handles with each pain are lifted and carried up over the woman's abdomen, very little force being employed. The outspread fingers and thumb of the left hand push the head away from the perineum and guide it upward under the pubic arch. When the pain passes off, the forceps-handles are allowed to sink again. Finally, just before the head emerges, the grip on the instrument is again changed so that the handles may be almost laid on the woman's abdomen (Fig. 626). Used in this way there is no better safeguard for the integrity of the pelvic floor than the obstetric forceps.

In the description of the application of the forceps it has been assumed that the head is in a normal oblique position of a vertex presentation and that the blades of the instrument are applied to the sides of the fetal head, where they do the least damage, and to the contour of which their cephalic curve has been adjusted. It often happens, however, that the head occupies an abnormal position, and the question arises whether the forceps shall be applied at the sides of the maternal pelvis, where the blades are not likely to injure the woman, or whether an

attempt must be made to adjust the blades to the sides of the fetal head regardless of the additional risk to the mother. If, for example, the head is transverse, as it usually is when detained at the pelvic inlet in a contracted pelvis, one blade must lie behind the symphysis and the other in front of the promontory if they are to be placed at the sides of the fetal head. It is possible to so adjust them, if one possesses manual dexterity and is skilled in the use of the forceps, but there is always a danger of perforating the posterior uterine wall in the attempt. It is better under these circumstances to place the blades obliquely, the posterior behind the promontory of the occiput, the anterior in front of the chin and mouth. By this adjustment the fetal head is not likely to be so badly damaged as if the forceps were applied directly over the face and the occiput, the anterior rotation of the latter is facilitated, and the woman is subjected to no extra risk.

It is not infrequently necessary to apply the forceps to the head in a normally oblique position, but with the occiput directed posteriorly. As the head descends, anterior rotation should occur, and it is to be considered whether the grip of the instrument will interfere with the rotary movement of the head upon the pelvic floor. As a rule, it does not if the precaution is observed to disengage the blades completely from each other by unlocking them after each tractive effort. If spontaneous rotation does not occur, the forceps is used as a rotator with each traction till the instrument almost turns upside down. As soon as rotation is accomplished, the forceps-blades must be rotated into their appropriate positions over the sides of the head, or, if it is difficult to do this, they should be withdrawn and reinserted. To give a concrete example: In a right occipitoposterior position of a vertex presentation the two blades of the forceps are inserted along the posterior walls of the pelvis to either side of the promontory; the right blade is then rotated forward until it lies under the right acetabulum. As the occiput rotates forward after encountering the resistance of the pelvic floor, the long anteroposterior diameter of the head shifts from the right to the left oblique diameter of the maternal pelvis, bringing the forceps-blades directly over the face and the occipital protuberance. The left blade must, therefore, be rotated forward and the right backward, or, if it is difficult to rotate the blades, they must be withdrawn and reinserted as for a right occipito-anterior position of a vertex presentation.

If the occiput rotates into the hollow of the sacrum, the head should be extracted from the vulvar orifice by the following manœuver: The forceps-handles are raised gradually and intermittently until almost the largest diameters of the head have

escaped; then, instead of continuing the elevation, the left hand firmly supports the head through the perineum and the forceps-handles are depressed, turning the fetal face out from behind the symphysis. In this way the perineum and pelvic floor are somewhat relieved of the tremendous strain imposed upon them in a persistent posterior position of the occiput. In applying the axis-traction forceps, the bars are closed against the blades, which are inserted in the ordinary manner. After adjusting the blades to the sides of the child's head if possible, or in an oblique diameter of the pelvis, the blades are locked; the pin-lock of Tarnier's instrument is screwed moderately tight; the connecting bar between the handles is thrown across, locked, and screwed until the blades take a firm but not too forcible grip on the fetal head. The traction bars are then sprung loose at their lower end and the handle is adjusted to them and locked. Traction should be made in a line as nearly as possible coinciding with the axis of the pelvic inlet—namely, backward and downward. To do this even approximately the woman must be placed upon a bed or table with her buttocks projecting well beyond the edge and the axis-traction handle of the forceps must be pulled downward and backward as far as possible. To protect the perineum from injury by the traction rods a Sims speculum should be held in place during the tractive efforts. Between the tractions the bar joining the handles should be unscrewed and thrown out of place and the pin-lock should be unscrewed, thus relieving the fetal head from continued pressure. As soon as the fetal head has descended well into the pelvic cavity the axis-traction principle becomes unnecessary. The handle should, therefore, be removed, the bars fastened in their places by the blades, and the forceps used as an ordinary instrument or else withdrawn and replaced by a Simpson forceps. Statistics as to the *frequency* of forceps operations have neither interest nor value. They vary enormously in different clinics, in different classes of society, and in the hands of different operators. The author is an advocate of the frequent use of forceps, believing that more harm arises from inordinate delay in labor to mother and infant than can be traced to the use of the instrument in careful and skilful hands. The *mortality* of a forceps operation, *per se*, should be *nil*. The

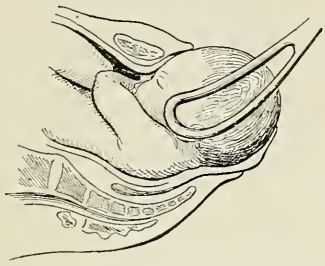


Fig. 627.—Overdistention of the perineum in persistent occipito-posterior deliveries; the nose rests under the pubic arch. The handles at this point should be depressed.

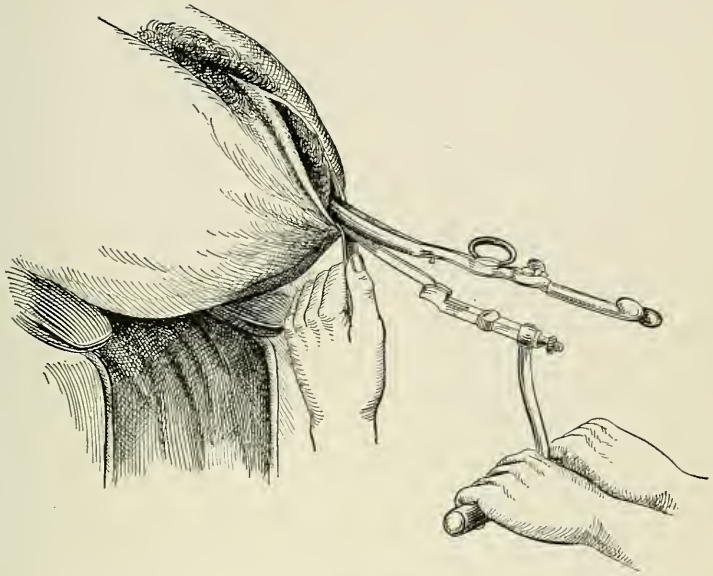


Fig. 628.—Axis-traction forceps; head at the superior strait.

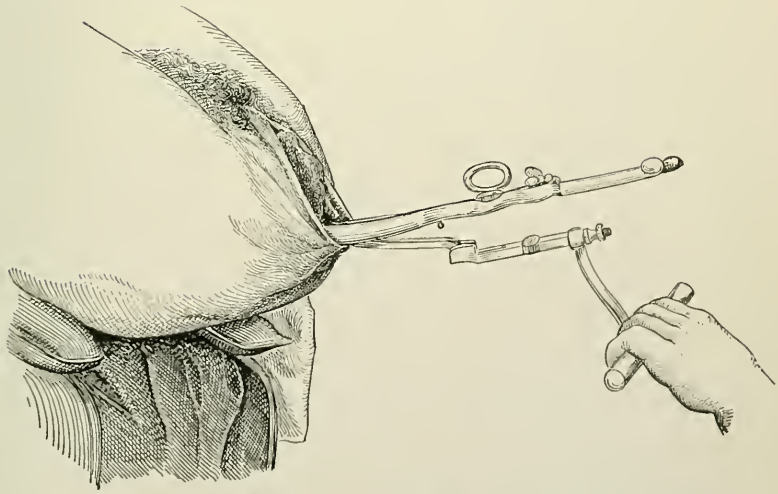


Fig. 629.—Axis-traction forceps; head in the pelvic cavity.

most frightful damage, however, has been inflicted upon both mother and child by the unskilful and careless use of the instrument. The pelvic joints have been sprung apart by too forcible traction; the lower uterine segment with an undilated os has been caught in the grip of the blades and has been cut through into the peritoneal cavity; the posterior wall of the lower uterine segment has been perforated by the tip of one blade; the child's scalp has been cut and a forceps-blade forced between its scalp and the skull; in an attempt to apply forceps to the breech in the mistaken notion that it was the head, the tip of a forceps-blade has torn the perineum of a female infant into the rectum; the vaginal vault has been perforated and the vaginal walls deeply cut, and frequently, indeed, is the pelvic floor torn, often into the rectum, by a failure to elevate the handles sufficiently and to moderate the tractive force as the head is extracted from the vulvar orifice.

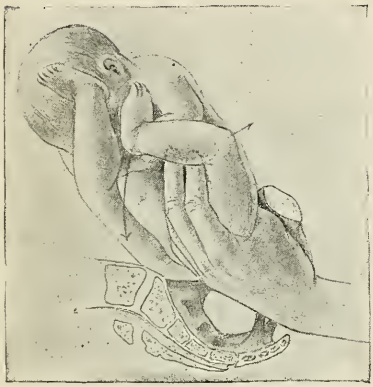


Fig. 630.—To bring down a foot when it is against the face, the knee may be bent by pressure in the popliteal space (modified from Farabeuf and Varnier).

EXTRACTION OF THE BREECH.

Breech labors are normally slow and tedious. The indications for interference are: delay for much more than twenty-four hours, rapid and feeble pulse, signs of exhaustion, elevation of temperature in the mother, and abnormally slow fetal heart-sounds.

Methods of Extraction in the Order of their Efficiency.—Manual Method.—Seizing a foot by passing a hand into the uterus, extracting the leg up to the knee, thus decomposing the breech presentation and affording a convenient handle to the fetus by which to control the subsequent progress of labor, is the best of all methods for extracting the breech, if it is practicable. Pinard's suggestion to push one thigh outward and backward, thus flexing the leg upon the thigh, occasionally makes it easier to grasp the foot.

Another plan of manual extraction is to place the hand on the infant's back, so that the little and fore-fingers hook over the crest of the ilium, while the middle and third fingers are ex-

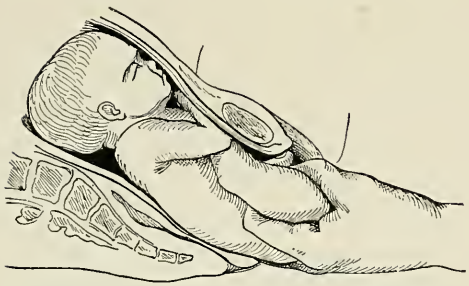


Fig. 631.—Manual extraction of breech.

Fig. 632.—Forceps on breech.

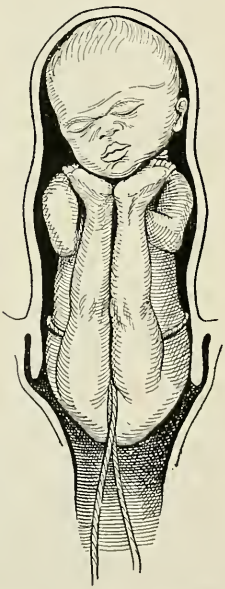


Fig. 633.—Fillet on breech.

Fig. 634.—Fillet carrier.

tended along the spine. This is not so good. For both manœuvers the patient must be anesthetized.

Forceps.—If the breech is low in the pelvic canal, and it is impossible to pass the hand into the uterine cavity to seize a foot, it may be most convenient to apply forceps over the trochanters. By avoiding compression of the handles, and simply making traction by hooking one's fingers over the

Fig. 635.—The handle of a long forceps used as a blunt hook.

shoulders of the instrument, the breech may be extracted readily, with no danger to the child.

Extraction by Fillet.—Each end of a strip of bandage about two inches wide may be passed between the thigh and the abdomen and brought down in front of the external genitalia. If drawn tight, the loop of the bandage is in contact with the child's sacrum. A firm and convenient grip is thus taken upon the breech. The fillet is very difficult to apply with the fingers. A fillet-carrier, shown in figure 634, makes the application easier. A still better

appliance is a fillet-carrier constructed like a Bellocq's canula. An anesthetic is required. This plan is excellent if the manual extraction is impossible, or if it is considered inadvisable to use forceps.

Blunt Hook.—This instrument is passed between the thigh and the abdomen. It is extremely dangerous for the infant. It is very likely, indeed, to fracture the thigh or to perforate the groin. It is, therefore, not recommended, and is never employed by the author unless the child is dead.

VERSION.

Version may be defined as an operation or manœuver to change the position of the fetus *in utero*. The object of version is usually to change a transverse into a longitudinal presentation, or to change the presentation of one pole of the fetal ellipse into a presentation of the opposite pole.

The changes in the position of the fetus are effected by four methods—postural treatment of the mother, external manipulation alone, internal manipulation alone, and a combination of internal and external manipulations. As the child is brought to present by the cephalic or pelvic presentation, the operation is called version by the head or version by the breech. If the foot is seized and is extracted in the operation of version, the operation is called podalic version.

The operation of version is an old one. Hippocrates speaks of the difficulties encountered when a child lies crosswise in the uterus. He compares it to an olive lying crosswise in a bottle with a narrow neck. But Hippocrates believed that the infant could only be delivered if it presented head first, and therefore, in cross-positions of the fetus, if the effort to turn it with the head toward the maternal pelvis did not succeed, embryotomy was to be performed by tearing the child to pieces with sharp hooks.

In some aboriginal tribes a woman is seized by the feet, suspended head downward, and vigorously shaken if labor is delayed.

In Japan, before the country reached its present high stage of civilization, it was customary to apply massage to the abdomen of pregnant women in order to straighten out a possibly faulty position of the fetal ellipse. In many primitive races some form of version has been and is in vogue, handed down as a custom of ancient origin.

Indications for Version.—The most important and the most frequent indication for version is found in a transverse position of the fetus *in utero*. In order to secure delivery, one or the other of the poles of the fetal ellipse must be substituted for the shoulder, which usually presents in a transverse position of the fetus.

Contracted pelves are an indication for the performance of version, when it is thought that the child's head can be brought through the contracted pelvic canal more easily with the small end of the wedge coming first than last. If it is necessary to deliver the mother rapidly, in cases of sudden danger, when the head is presenting but not engaged, as in eclampsia, premature detachment of the placenta, rupture of the uterus, embolism, and death of the mother, podalic version furnishes the most rapid means of delivery. In malpositions of the head, as presentation of the ear, of one parietal bone, of a brow or face, it may be better to substitute for the unfavorable presentation of the head the more favorable presentation of the breech, which is secured by podalic version, or by version by the breech. In placenta prævia, if the head is presenting, version is indicated, in order to bring down the breech as an intrapelvic tampon upon the bleeding placental site. In prolapse of the umbilical cord, version is indicated if the cord can not be returned into the uterine cavity and kept there.

Before undertaking the operation of version, it is quite as important to realize the contraindications to the operation as it is to recognize the indications. Version is positively contraindicated if the presenting part is firmly engaged in the pelvic canal and has passed out of the external os; also, if the contraction-ring is so high that a rupture of the lower uterine segment is threatened if version is attempted.

While these are the only positive contraindications to the operation, the following conditions may make it difficult, dangerous, or quite impossible:

An undilated and undilatable vagina; a similar condition of the cervix. These obstructions may usually be overcome under anesthesia, but they may be insuperable obstacles to the performance of version.

It may be impossible to effect an entrance into the uterus, as when the liquor amnii has long been drained away and the uterus is firmly contracted, if the uterus is permanently contracted in what is called a tetanic spasm, if there is some obstruction on the part of the fetus, as hydrocephalus and spina bifida with a large meningocele, or if the presenting part is pressed firmly upon the superior strait. The last-named difficulties may be obviated by placing the woman in the knee-chest posture.

Prolapse of the arm, at one time considered a serious obstacle to the performance of version, is no longer so. The physician's hand can readily pass by the arm, and indeed it is sometimes an advantage to pull the arm out of the external os before attempting version.

It may be impossible to bring the feet down in podalic version after they are grasped. This difficulty may be overcome by

applying a fillet to the foot, and, while traction is made upon it, the other hand of the physician in the vagina pushes the shoulder upward and in the direction of the child's head.

In a case of the author's the shoulder and head were locked in the cornua of a uterus condiformis, making version impossible.

Certain conditions may interfere, also, with the manipulation of the external hand in combined and in podalic version, as an excessive amount of fat in the abdominal wall, or convulsions in eclampsia, epilepsy, chorea, and hysteria. On the other hand, the conditions most favorable for the operation are: a uterus distended by liquor amnii, a dilated os, a uterine muscle that is not irritable, abdominal muscles that are flexible and thin, and a cervix well dilated or easily dilatable.

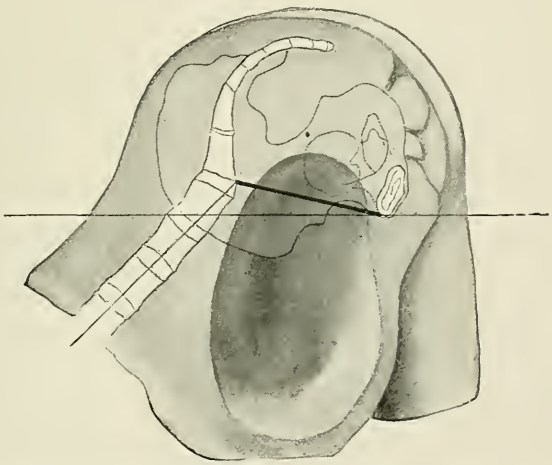


Fig. 636.—Diagram of knee-elbow posture for internal version. The lower part of the hollow of the uterus is lifted out of the pelvis (Dickinson).

Postural Version.—In this method the woman is put in different positions to influence the position of the child by the force of gravity. For example, if the brow presents, the woman is turned on that side toward which the fetal back looks, so that the breech may drop to that side, and thus bring the vertex to the center of the superior strait; or, if the head should be tightly fixed in the superior strait, the woman may be turned on that side toward which the face looks, in order to promote the flexion of the child's head, and thus favor a conversion of the brow presentation into one of the vertex.

This is a simple, safe, and easy means of performing version, if practicable, but it usually fails.

Version by external manipulation may be used before

labor to convert a breech presentation into a presentation of the head, or to correct a transverse presentation. When the child has been brought into the position desired, by a series of stroking movements, pads and a binder should be applied to prevent the return of the child to its original position. This method, while successful in a fair proportion of cases, requires often an expert's skill; a diagnosis of the position before labor has begun; the preservation of the membranes; thin, flexible uterine and abdominal walls, and non-irritable muscles.

Combined version was first proposed by Busch, D'Outrepont, and by Dr. Wright, of Cincinnati, and was later advocated by Braxton Hicks, of London. The operation is performed as follows: The patient is placed in the dorsal position and is anesthetized. Externally, the hand nearest the fetal part to be acted upon by external manipulation seizes this part through the abdominal walls, the operator being seated facing the vulva. The internal hand pushes the presenting part up and to that side opposite the fetal part acted upon by the external hand. For example, in a shoulder presentation, with the face of the child turned forward and the head in the right iliac fossa, the physician seizes the head with his left hand, inserts the right hand in the vagina, and with two fingers of this hand passed into the uterine cavity pushes the child's right shoulder upward and toward the mother's left-hand side, while the head by external manipulation is pulled downward and toward the median line. In all shoulder presentations, version by the head should be preferred to version by the breech in the combined method, for this presentation is more favorable to the child, and the head is more readily brought to present at the superior strait, making the version easier and quicker than if the breech were brought down.

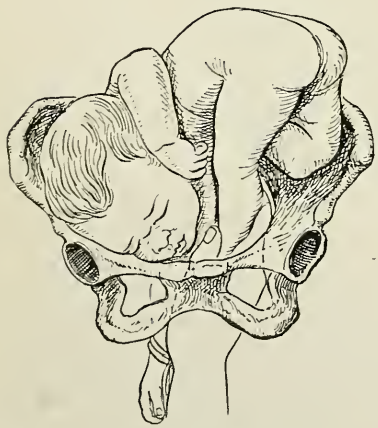


Fig. 637.—Version in dorsoposterior position (Farabeuf and Varnier).

Podalic version was known in the time of the Roman Empire, but was forgotten in the middle ages until Ambrose Paré and his students revived it in the sixteenth century. The operation is performed as follows: Relaxation of the uterus and of the abdominal muscles is secured by an anesthetic. The lowest

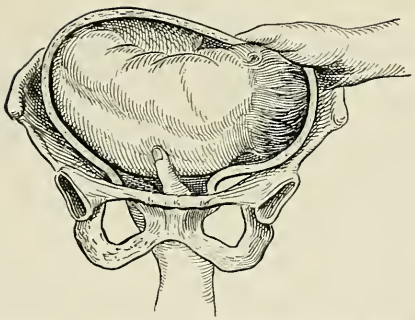


Fig. 638.—D'Outrepont's method of combined version, modified by Scanzoni.

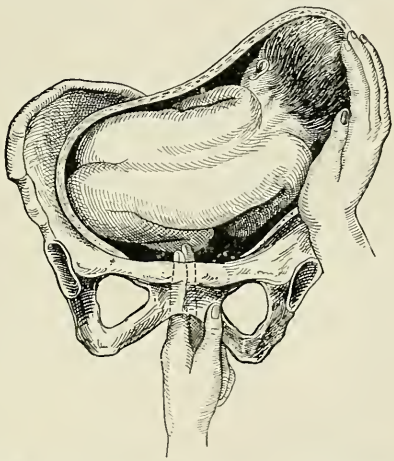


Fig. 639.—Combined version by the breech.

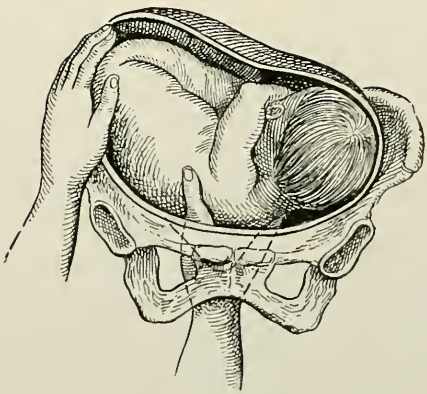


Fig. 640.—Combined version, Wright's method.

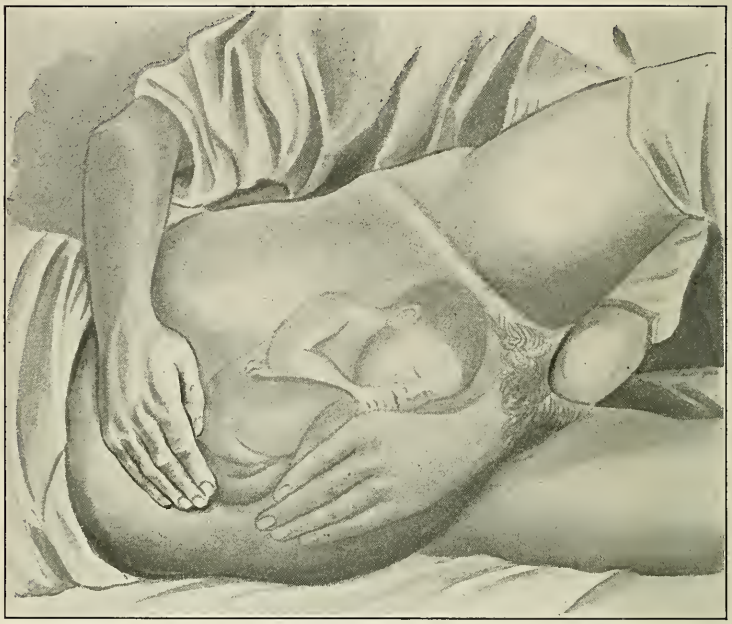


Fig. 641.—Seizing the anterior foot in podalic version (Nagel).

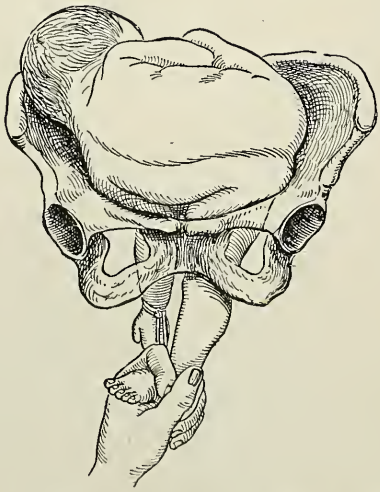


Fig. 642.—Version in dorso-anterior position, first stage of traction on lower limb (Farabeuf and Varnier).

possible position of the fetal feet is secured by turning the mother on that side toward which the feet point. The hand which, midway between pronation and supination, as the operator faces the woman's vulva, corresponds with its palmar surface to the abdomen of the child is inserted into the uterine cavity, until it meets the anterior foot. This foot is grasped by the first two fingers and the thumb, and is then extracted until the knee appears at the vulva.

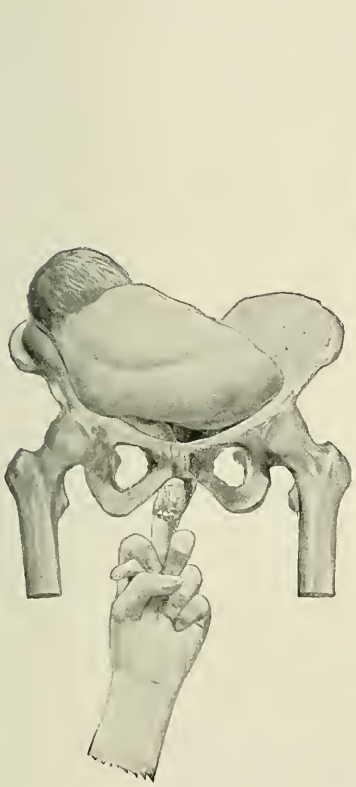


Fig. 643.—The upper buttock is moving downward and the lower shoulder rising (Dickinson).

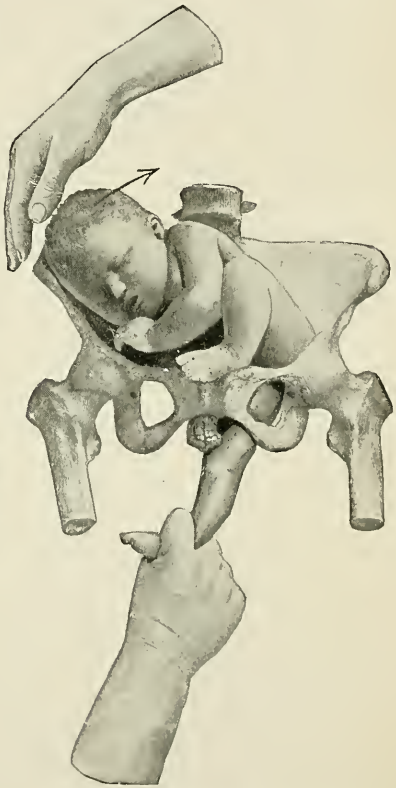


Fig. 644.—Assisting podalic version by external manipulation (Dickinson).

The advantages of resting content with the anterior foot, and of drawing upon it alone without seeking for the other, are these: A further entrance into the uterus is unnecessary. It is easier to hold one foot than two. The other leg is folded upon the abdomen, and thus secures a more thorough dilatation of the cervical canal. Finally, by pulling upon the anterior foot one

is more likely to secure a sacro-anterior position of the breech. While making traction upon the foot, the version of the child is facilitated by external manipulation of the head (Fig. 644). It is

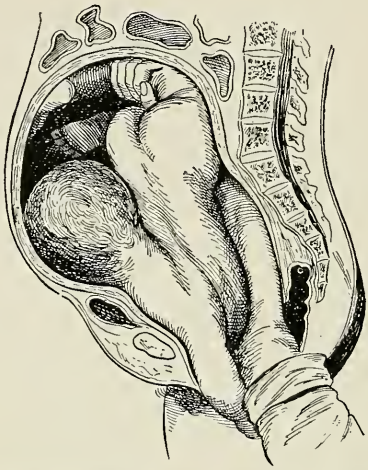


Fig. 645.—Seizing the leg instead of the foot.

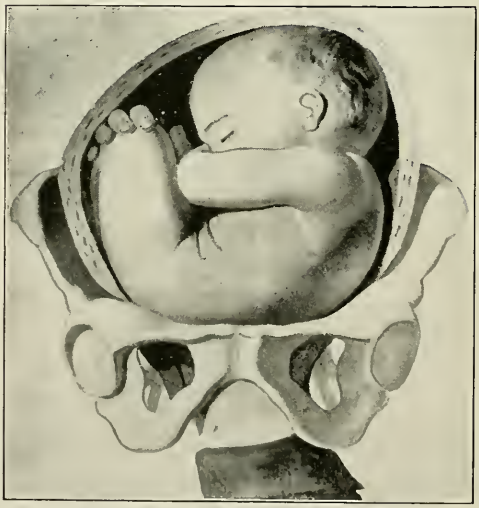


Fig. 646.—Seizing a knee instead of the foot.

occasionally easier to seize a leg or the knee than the foot (Figs. 645, 646). In such a case time need not be wasted seeking for the foot. Combined version by the breech may precede or re-

place podalic version with great advantage, as first pointed out by Braxton Hicks, obviating the necessity of introducing the hand into the uterine cavity and enabling the operator easily to seize the knee or foot after it is brought near or into the superior strait.

As soon as the knee is born, the operation of podalic version is finished, and, unless there is some indication for immediate

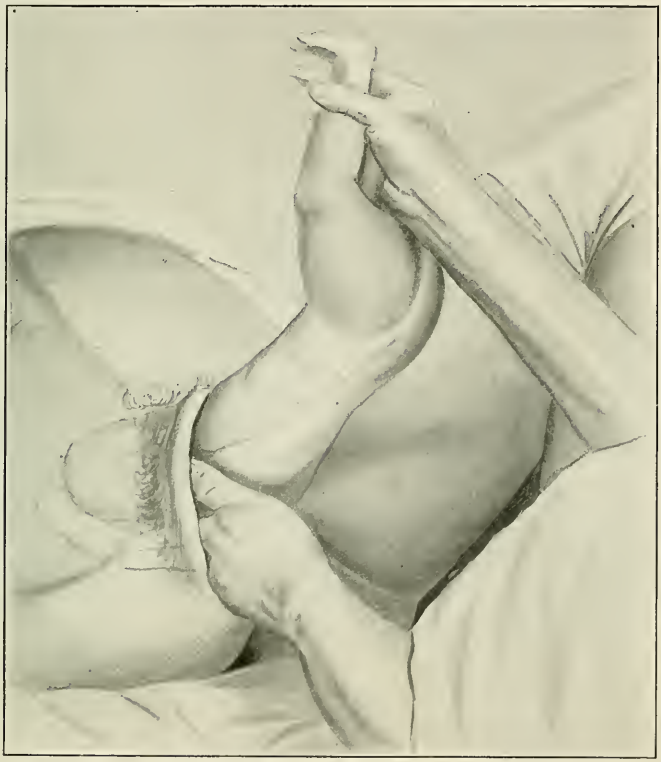


Fig. 647.—Extracting an arm (Nagel).

delivery, the anesthetic should be removed, the patient should be turned upon her back, and should be allowed to expel the child spontaneously until the umbilicus appears in view. The delay secures a more thorough dilatation of the cervical canal, and produces a paretic condition of the circular muscle of the cervix. The advantages of this condition of the cervix are obvious when it comes to the extraction of the after-coming head. With an undilated cervical canal and a rigid cervical muscle, the neck is likely to be grasped in so firm a hold that

all efforts to extract the head are unavailing until the child is asphyxiated. In rare cases rapid extraction may be indicated. If it is, the legs and trunk are pulled upon forcibly, as shown in figures 648 and 649. The child's body being slippery, should usually be enveloped in a towel. When the child is born to the umbilicus the pressure upon the cord is great, and delay in its extraction means an asphyxia so deep that it is unlikely the child can be revived. From this moment, therefore, the attendant must put forth every effort possible to secure the most rapid delivery of the infant, which is effected by the following methods: The arms, if extended alongside of the child's head, as they usually are after version, must be extracted in the following manner: locate the posterior arm by the position of the trunk and shoulders. To deliver the right arm, grasp the legs with the left hand, the middle finger above the internal malleoli, the index and middle fingers above the ex-

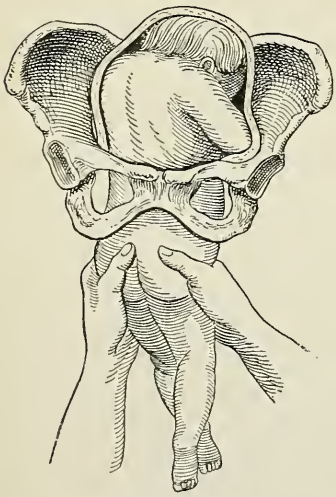


Fig. 648.—Method of seizing the breech.

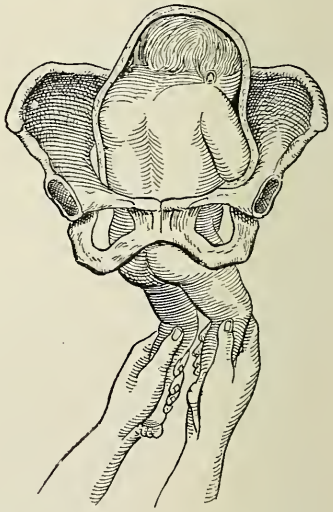


Fig. 649.—Method of seizing both feet.

ternal malleoli. Raise the child's body upward and outward over the mother's right thigh. This movement should be sufficiently forcible to bring the right shoulder well down in the pelvis. The first two fingers of the right hand, entering the vagina in contact with the right scapula, are passed along the posterior surface of the arm beyond the elbow, when the arm and forearm are pushed in front of the child's face as though the

elbow joint did not exist. The fingers are now hooked in the elbow-joint and pulled directly downward until the elbow appears at the vulva, the forearm being flexed by this movement upon the arm. The forearm is then easily delivered by extension. The left arm is brought down and delivered in the same manner, substituting, of course, right for left. The right hand grasps the child's feet and lifts them over the mother's left thigh, at the same time rotating them on their long axes so as to twist the body and thus bring the anterior arm into the posterior portion of the pelvis. The fingers of the left hand are inserted into the vagina past the elbow-joint. The arm is swept forward over the face, as though it were a single piece without the elbow-joint. The elbow is then flexed, pulled downward, and the forearm extended at the

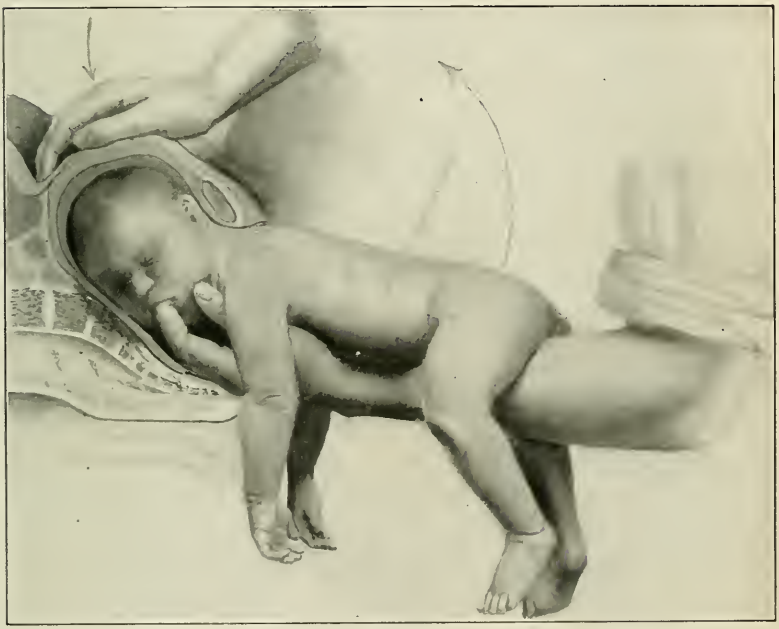


Fig. 650.—Delivery of the after-coming head by flexion through seizure of lower jaw, and extrusion by means of pressure in axis of brim (Dickinson).

vulvar orifice. Should the shoulders occupy a transverse position, either arm may be brought down and delivered first. After delivering the arms, the head may be extracted by one of the following methods, given in the order of their efficiency and safety:

Wigand's Method.—In this method the first three fingers of the supinated hand are inserted into the vagina, that hand being employed whose palm corresponds to the abdomen of the child. Over the forearm of this hand the child's body rests astride.

Fig. 651.—First step of Mauriceau's method, an assistant making suprapubic pressure on the head.

The index-finger of the hand in the vagina is inserted in the child's mouth, care being exercised to avoid the eye-sockets. Sufficient traction is exerted upon the lower jaw to secure and

maintain flexion of the head. The disengaged hand now locates the head through the abdominal wall above the pubes, and delivery is accomplished by suprapubic pressure in the axis of the parturient canal, and by the elevation of the child's body toward the mother's abdomen.

Mauriceau's Method.—One hand is inserted in the vagina, as described above, and one finger is placed in the child's mouth. The other hand is passed along the child's back until the middle finger rests upon the occipital protuberance. The index- and

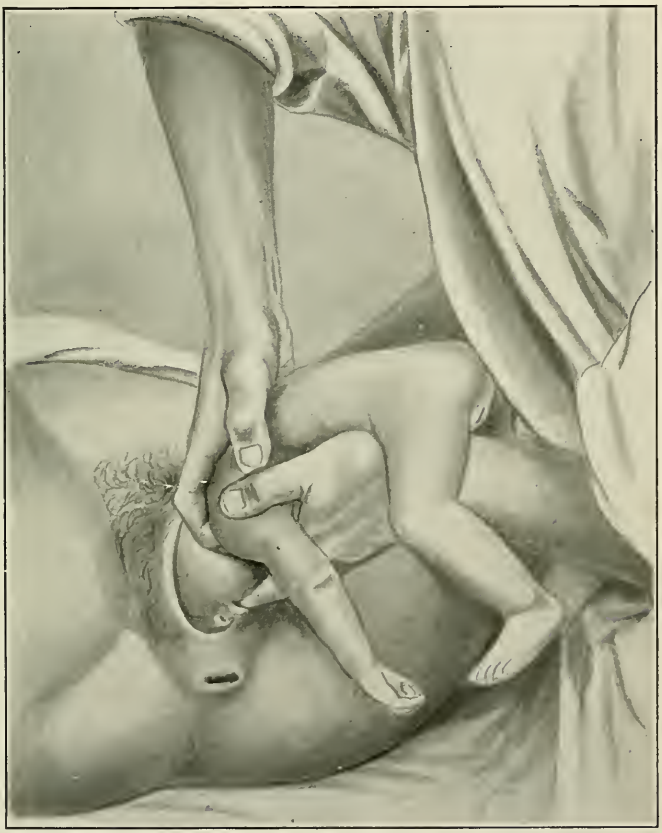


Fig. 652.—Second step of Mauriceau's method.

ring-fingers are flexed over the clavicles, and traction is made by both hands at once, the force upon the jaw and the pressure upon the occipital protuberance keeping the head well flexed, while the traction upon the shoulders extracts the head in the

direction of the parturient canal. As the head descends upon the pelvic floor, the child's body is carried upward toward the mother's abdomen. Properly directed suprapubic pressure by an assistant increases the efficiency of this method, and makes it, indeed, the most effective of all methods in extracting the after-coming head. Combined with the Walcher posture in the mother it should be the method of election in cases of contracted pelvis.

Prague Method.—The child's ankles are grasped with the right hand pronated, the middle finger being placed between the legs just above the internal malleoli, the index- and ring-fingers above the external malleoli. The index-finger of the left hand is flexed over one clavicle, and the remaining fingers of the same hand over the other clavicle. Traction directly downward is now made with both hands until the perineum is well distended.

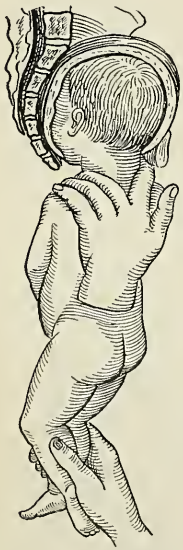


Fig. 653.—The method of extracting the trunk.

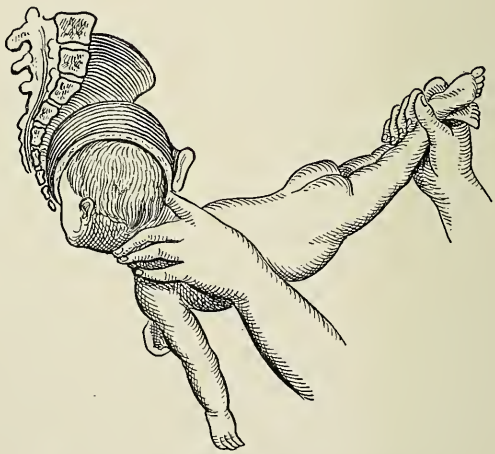


Fig. 654.—The Prague method of extracting head.

The right hand then loosens its hold upon the ankles, and again grasps them as described above, but approaching them at their anterior surface. The child's feet are now in contact with the back of the right hand. The feet are then raised by a circular movement toward the mother's abdomen, while the left hand as originally placed is used as a fulcrum, around which the head moves until it is finally forced out of the parturient outlet by a lever-like movement on the part of the child's body.

Forceps.—An assistant should raise the child's body, supporting its arms and legs, and thus keeping them out of the way of the operator, who rapidly applies the blades to the sides of the child's head. Traction is made in the direction of the axis of the parturient canal, and the head is finally delivered by lifting the handles of the forceps, the disengaged hand protecting the perineum as much as possible.

Deventer's Method.—The child's body is seized as in the Prague method, but the arms are still alongside the child's head

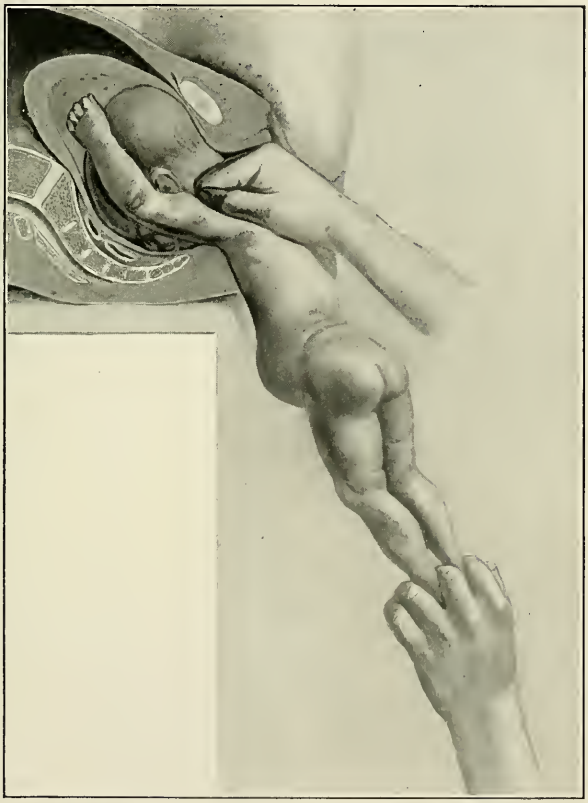


Fig. 655.—Deventer's method of extraction of the after-coming head and arms (Dickinson).

and need not be extracted first. The body is pulled directly downward toward the ground, until the shoulders descend and press upon the pelvic floor. The child's body is then carried downward and backward under the woman's buttocks, the head

being rolled out of the parturient outlet between the arms, which easily follow after. To do this the woman's buttocks must project well beyond the edge of the bed, and the child must be carried well under them. The operation is only possible under the most favorable conditions, and is not always to be relied upon. It has, however, the merits of simplicity and rapidity.

EMBRYOTOMY.

Embryotomy is a mutilating operation upon the fetus. The term is generic, and includes the following operations: Craniotomy, decapitation, evisceration, and amputation of the extremities.

Craniotomy.—In this operation the child's head is perforated, the contents evacuated, and the head thus diminished in size. The forcible extraction of the evacuated head is often also a part of the operation. The operation may be indicated upon a dead or upon a living child. In the former case the indications for the operation may be comparatively trivial. If the mother can be saved any additional risk or suffering by the rapid delivery of the mutilated child, craniotomy is not only justifiable, but advisable. In case of prolapse of the umbilical cord, with a contracted pelvis, the commonest condition that calls for craniotomy upon a dead infant, it is far better to open the head and to deliver the child easily with a cranioclast, than to apply the forceps to the head at the superior strait and to subject the mother to the delay, pain, and danger of a prolonged forceps operation, when nothing is to be gained by it.

Craniotomy upon the living child is only justifiable in exceptional circumstances. To condemn this operation, however, unreservedly and without exception is a mistake. In cases of difficult labor, if the pelvis is contracted or the child overgrown, and the physician must make a choice between Cesarean section, pubiotomy, or craniotomy, if he has no skill in surgical work and is unable to procure expert assistance, it is better, unquestionably, to sacrifice the child for the mother's sake, rather than to attempt a serious surgical operation, amid unfavorable surroundings, and performed by an unskilful operator whose mortality must be very great.

Every attempt must be made to avoid the destruction of a living child, of course; and if the operator feels himself possessed of sufficient skill to attempt the more serious operations of Cesarean section or pubiotomy with fair prospect of success, or if he can summon to his aid an expert surgeon, he should not think of performing craniotomy upon the living child. But under certain circumstances

craniotomy upon a living infant is a justifiable operation, and one not to be unreservedly condemned.

The Instruments for the Operation.—Embryotomy is the oldest operation of obstetrics and the instruments for performing it make an interesting historical collection. The sharp hook or crotchet in its numerous forms had a place in the obstetrician's armamentarium for many centuries. At the present day the operator may need for craniotomy a perforator, a head seizer

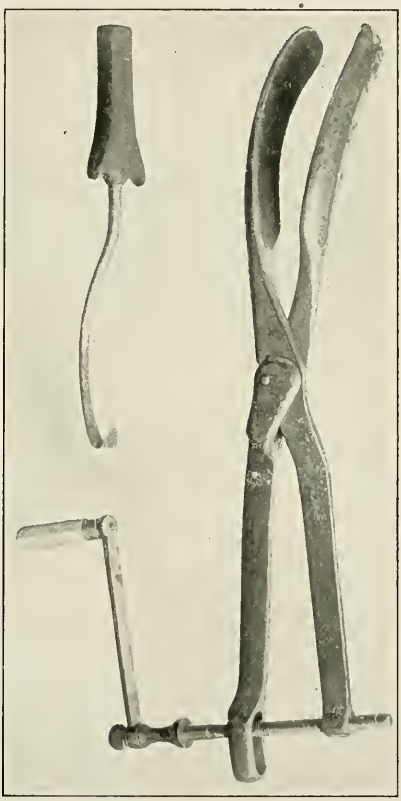


Fig. 656.—A, Sharp hook or crotchet; B, Baudelocque's cephalotribe.

or cranioclast, and a head crusher in its various forms of cephalotribe, basiotribe, or basilyst.

Perforators.—The best perforator is Blot's. Smellie's perforator or Hodge's scissors answer the purpose well enough, and in the absence of an instrument specially devised for the purpose, any long, sharp-pointed scissors serves admirably.

Fig. 657.—Smellie's perforator.

Fig. 658.—Blot's perforator.

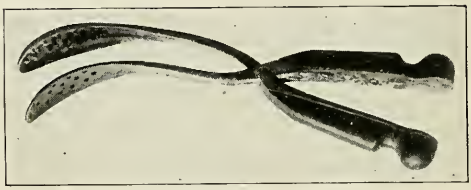


Fig. 659.—Oldest form of cranioclast.

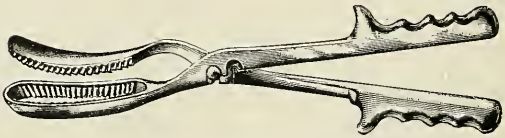


Fig. 660.—Simpson's cranioclast.

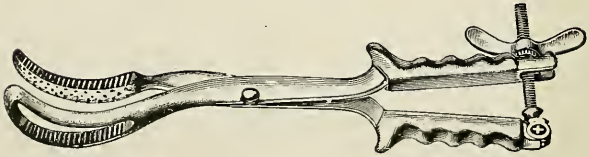


Fig. 661.—Braun's cranioclast.

Fig. 662.—Cranioclast modified by the author with a pelvic curve which Braun's does not possess.

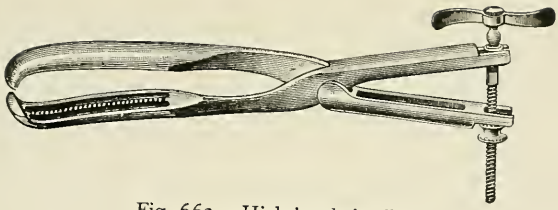


Fig. 663.—Hicks' cephalotribe.

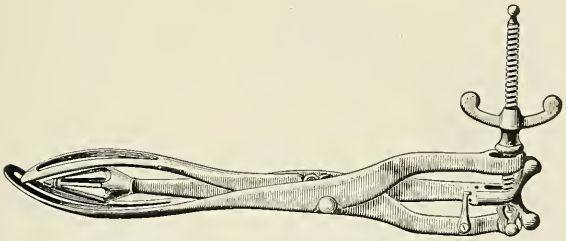


Fig. 664.—Tarnier's basiotribe.

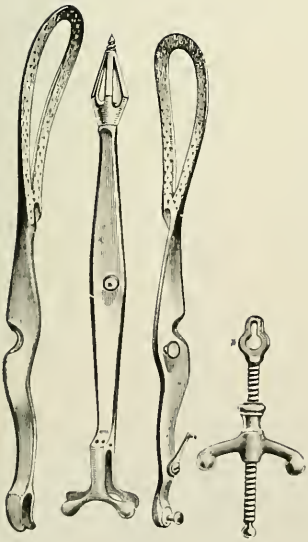


Fig. 665.—Tarnier's basiotribe (separate parts).

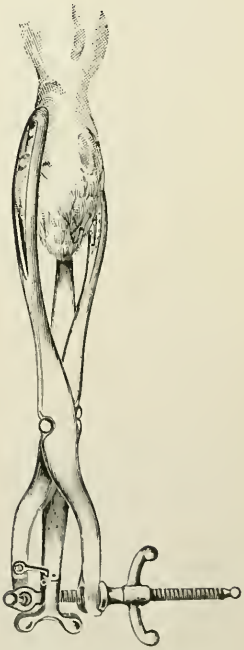


Fig. 666.—The second blade of the basiotribe has crushed the sinciput.

Head Seizers or Cranioclasts.—This instrument was invented by Sir James Y. Simpson. It has been much improved by Carl Braun and the author has added to the latter instrument a pelvic curve, which facilitates its application at the superior strait. The cranioclast is made with two blades: one for insertion inside, the other outside, the skull. The handles are provided with a screw and nut to bring them close together, so as to give the blades a powerful grip upon the skull.

Head Crushers or Cephalotribes.—The cephalotribe is the invention of the younger Baudelocque. It is simply a heavy, powerful forceps with the handles screwed together so as forcibly to compress the skull between the blades. The best cephalotribe is Tarnier's *basiotribe*, which combines a perforator and a powerful head crusher.

Other modern instruments for the extraction of the mutilated

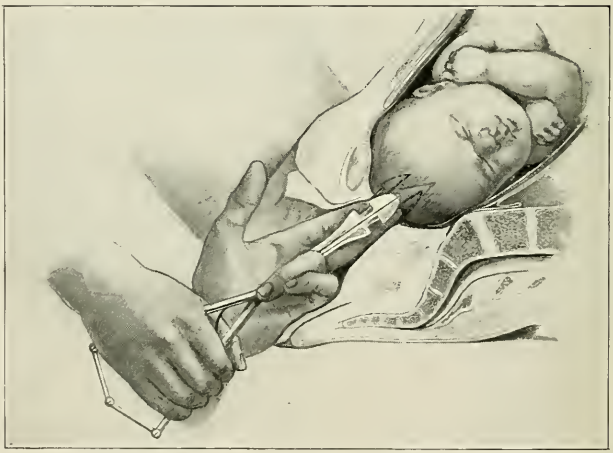


Fig. 667.—Perforation of the head begun: the right hand is grasping the handles of the instrument. The tips should not be separated until they have entered the fontanel (Dickinson).

head are Simpson's basilyst and Van Huevel's laminator. The latter is designed to saw off the face and the occipital protuberance. A wire écraseur answers the purpose perfectly well, as was shown by Barnes. In addition to these instruments, the operator needs a heavy volsella forceps and a large metal catheter to break up the brain and to wash it out of the skull.

The technic of the operation is as follows: The woman should be anesthetized not so much because the operation is painful or prolonged, but to spare her the sight of her mutilated

infant. The patient is placed in the lithotomy position, and brought well to the edge of the bed or table on which she lies. The child's scalp is seized by a strong volsella forceps, which is handed to an assistant, who pulls upon the instrument firmly, so as to fix the head at the superior strait. The operator then inserts two fingers of his left hand and feels for a suture or a fontanel. The perforator is inserted into the vagina, along the palmar surface of the fingers, and is plunged into the skull at a point upon which

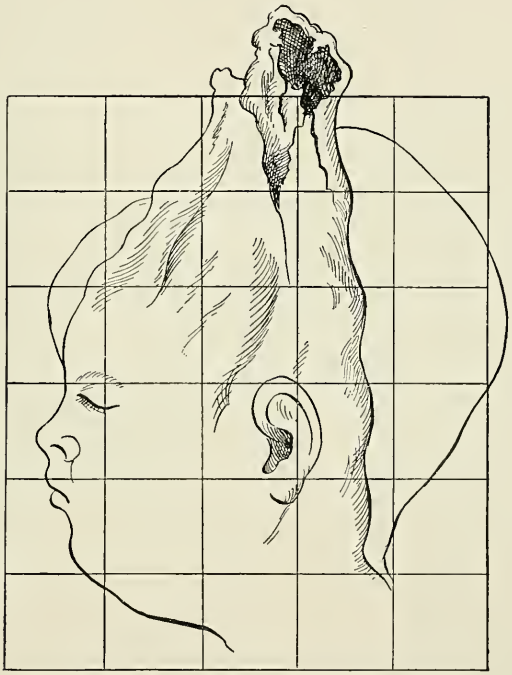


Fig. 668.—The head after delivery by the cranioclast.

the finger-tips rest—that is, through a fontanel or a suture. When it has entered the skull the perforator is twisted about in all directions, in order to break up the brain, and is also opened in several different directions to enlarge the opening in the skull. The large catheter is next inserted and attached to a syringe. A column of water is injected into the cranial cavity to wash out the remaining brain-substance. Next, if it is necessary, the size of the emptied head may be reduced with a cephalotribe. This is only called for in case of extreme pelvic contraction, or in the presence of some

pelvic tumor seriously diminishing the capacity of the pelvic canal. In the majority of cases a cranioclast may be used instead of the cephalotribe. The internal branch of this instrument is inserted within the skull. The outer branch is next introduced in the same manner that one would insert a blade of the forceps. The two branches are then locked, and the handles are screwed firmly together, care being taken that the internal branch is inserted deeply within the cranial cavity, so that it shall get a firm grasp upon the skull. The child is now extracted in the same manner that one would extract the head with the forceps, except that the tractive efforts are made uninterruptedly and with greater

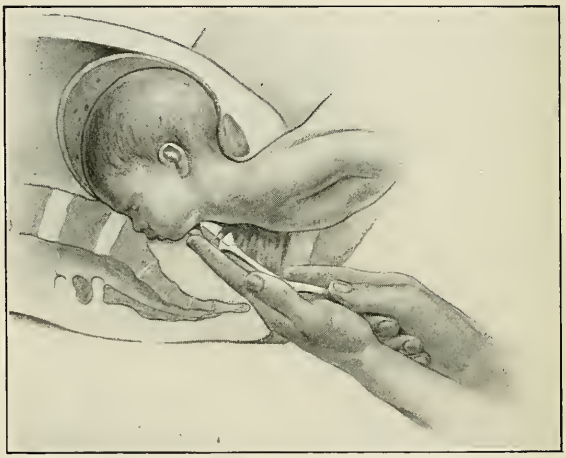


Fig. 669.—Craniotomy on the after-coming head: one method of perforating (Dickinson).

force. In certain cases it is sufficient simply to perforate the skull. This applies particularly to cases of hydrocephalus. The head being evacuated, the forces of nature are sufficient to insure the child's delivery. If it is necessary to perforate the after-coming head, the perforator may be inserted behind the ear, in the lambdoid suture, under the chin, through the roof of the mouth, or, possibly, through the foramen magnum. In a case of hydrocephalus with breech presentation, should there be great difficulty in reaching the after-coming head, it is possible to evacuate the fluid by perforating the spinal column and passing a catheter through the spinal canal into the cranium.

Decapitation.—The chief indication for decapitation is an impacted shoulder presentation, in which it is impossible to do

version, either on account of the inability to move the child or because of the risk of ruptured uterus owing to the enormously distended lower uterine segment. The instruments needed for

Fig. 670.—Braun's hook.

this operation are a Braun hook or a Ramsbotham sharp hook. The former is fastened firmly over the child's neck, when with two or three sharp turns of the wrist the neck is broken, and the soft structures may then be pulled through with the hook alone, or may be severed with scissors. The Ramsbotham knife-edged hook is passed over the neck, and by a rocking motion is made to cut through all the tissues of the neck.

In the absence of specially devised instruments for the purpose, a string may be carried over the neck and the child decapitated by a sawing movement with the string, the vagina and perineum being protected by a Sims speculum.

Amputation and evisceration are very rarely indicated. Some forms of monstrosities may possibly require these operations. A long-handled scissors is the best instrument for the purpose.

Cutting or breaking the clavicles (*cleidotomy*) was proposed on theoretical grounds to secure delivery of the shoulders. I found it once of great service.

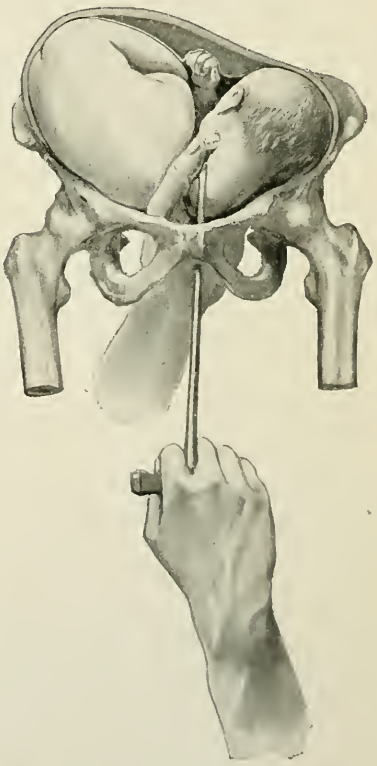


Fig. 671.—Decapitation with Braun's hook (Dickinson).

SYMPHYSEOTOMY.

The operation of symphyseotomy is a division of the pubic joint, allowing a diastasis of the bones during labor, the child being extracted through the natural passage. The operation was suggested for the first time in 1598, and was performed for the first time on a living woman in 1777 by Sigault in Paris. For a time symphyseotomy was in high favor, but the mortality that followed it, and the accidents which frequently marred its success, prejudiced the medical world against it, and it gradually died out. In 1866 the operation was revived in Italy, and from that time to 1886 it was performed 71 times with a death-rate of 25 per cent. The success achieved in the latter years of this period attracted the attention of the Parisian school of obstetricians. The operation was revived in its original home, and this revival was followed rapidly by its adoption throughout the civilized world. In the following three years there were 74 operations in the United States, with 10 maternal deaths and 18 infantile deaths. The mortality for America is about 12 per cent., but certain operators abroad have had as many as 20 cases in succession without a fatal result, and in Italy 54 symphyseotomies have been performed with but 2 deaths. It may be said that Cesarean section has a slightly higher mortality in the mother than symphyseotomy in the hands of a surgeon not specially trained, but a decidedly higher infantile mortality. The expert abdominal surgeon, with a thoroughly aseptic technic, should have a very low and about an equal maternal mortality in both operations.

A separation of the symphysis up to 7 cm. ($2\frac{3}{4}$ in.) secures an increase in the anteroposterior, the transverse, and the diagonal diameters of the pelvis of 1.4 cm. (0.55 in.), 3.1 cm. (1.22 in.), and 3.5 cm. (1.4 in.) respectively. It is possible to achieve success with a conjugate as low as 6.5 cm. (2.56 in.), but in a pelvis so badly contracted symphyseotomy is more dangerous than Cesarean section, and it is possible that after the symphysis is severed it may be found necessary to deliver the child by craniotomy.

The indications for symphyseotomy are very limited. If section of the pelvis is required at all, pubiotomy is to be preferred. There are few surgeons to-day who perform symphyseotomy. I shall not do it again.

The Technic of the Operation.—To perform the operation according to the Italian plan the technic is as follows:

The abdomen and pubic region should be cleansed as though for an abdominal section. An incision is made just above the symphysis, about an inch long, through the skin, fat, and superficial fascia. The attachment of the recti muscles to the pubic

bones is then severed by a transverse cut just sufficient to admit the forefinger behind the symphysis. The forefinger of the left hand is passed behind the symphysis and hooked

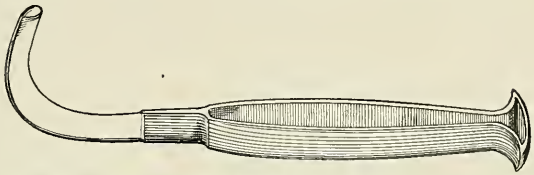


Fig. 672.—Galbiati's knife for cutting the symphysis.

Fig. 673.—Author's knife for cutting the subpubic ligament.

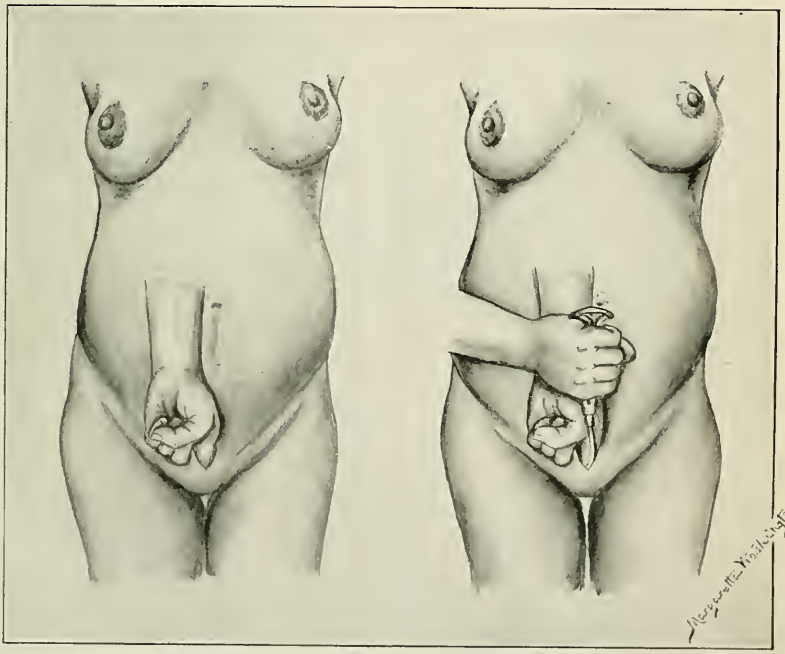


Fig. 674.—Subcutaneous section of the symphysis.

under it, while an assistant inserts a metal catheter in the woman's urethra, holding it down and a little to one side, usually the woman's right. The curved or sickle-shaped knife

of Galbiati is then seized firmly in the right hand and passed along the index-finger of the left hand until it glides under the symphysis. With an upward and forward rocking movement of the knife the symphysis is divided. It will almost invariably be found that this incision has failed to divide the subpubic ligament. To cut this, a smaller curved knife is inserted into the wound and passed under the ligament, which is then severed, from below upward, without difficulty. At this point in the operation there is usually a good deal of hemorrhage, which

Fig. 675.—French method of performing symphyseotomy (direct incision).

occasionally is most alarming. It can be checked at once, however, by packing the wound firmly with a strip of sterile gauze. During this part of the operation two assistants hold the woman's thighs equally flexed and at an equal distance apart from the middle line. Each assistant should also support the pelvis by firm pressure with a hand upon the trochanters. If the child's head is presenting, axis-traction forceps should be applied to it, and the head slowly and interruptedly extracted along the parturient canal, at each tractive effort the assistants being warned to exert firm lateral pressure upon the pelvis to prevent too great separation of the pubic bones, which would endanger the integrity of the sacro-iliac joints. As soon as the child is born, the knees of the woman are brought together and the thighs are somewhat extended. The operator then removes the gauze packing from

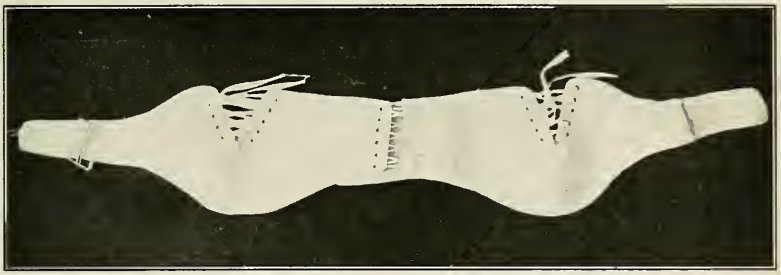


Fig. 676.—Author's canvas binder for symphyseotomy.

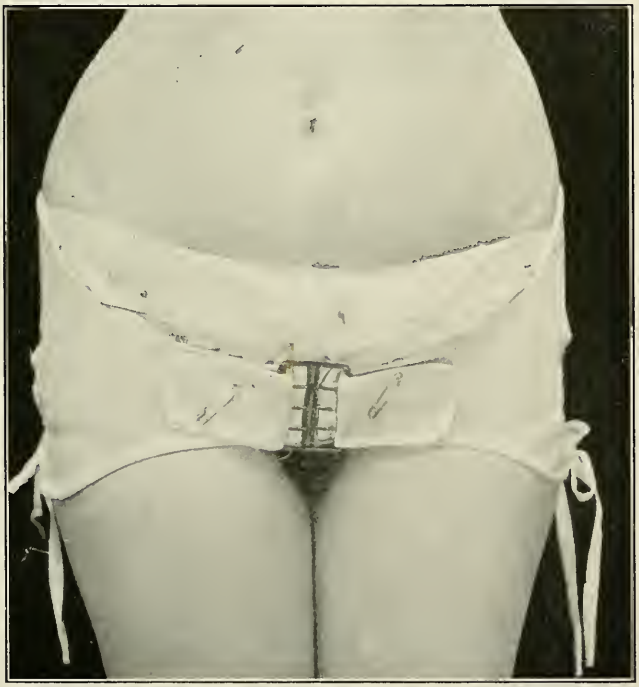


Fig. 677.—Binder for use after symphyseotomy, applied and fastened.

the suprapubic wound, inserts a finger behind the symphysis to see that the bladder is not nipped between the pubic bones, and sews together the abdominal wound with three or four silkworm gut sutures. It is unnecessary to suture the pubic bones of the symphysis. A dressing of aseptic gauze, cotton, and adhesive strips is applied to the wound. A firm binder is placed about the hips, and the woman is put in bed straight upon her back, upon an even mattress, which should be firm enough not to allow of sagging where the woman lies upon it. It is an advantage to support the sides of the pelvis with sand-bags during the woman's convalescence. They should be placed directly alongside the hips, extending at least to the knees.

The after-care of a symphyseotomy is exceedingly troublesome. The patient must usually be catheterized; the vulva and the surrounding regions must be kept clean. A special bed has been devised for the after-care of symphyseotomy, which makes convalescence more comfortable to the woman and easier for her care-takers.

In the French method of performing symphyseotomy an incision is made directly over the joint, which is then cut with an ordinary scalpel.

HEBOTOMY, HEBOSTEOTOMY, OR PUBIOTOMY

Section of the pubic bone in the region of the pubic spine was proposed by Gigli in 1894 as a substitute for symphyseotomy. Doederlein modified the operation by making it subcutaneous. The idea was to escape the injuries to the bladder and the infection which not infrequently followed symphyseotomy. A small opening is made above the pubis in the region of the pubic spine on the side toward which the occiput is directed; the periosteum is incised and pushed back; a specially constructed ligature carrier is passed behind the pubes, emerging below through a small incision in the labium majus or at its junction with the labium minus, or as far away from the vulva orifice as it can be made to emerge by pulling the skin toward the middle line before incising it. By this means a Gigli saw is passed upward through the first incision and the bone is severed. An immediate diastasis of 1 to 1½ cm. is secured, increasing to 4 cm. as the head passes through the pelvic canal. Considerable hemorrhage from laceration of the crus clitoridis is the rule. After delivery the small wounds are closed with collodion dressing and the pelvis is supported by a firm binder. Some operators prefer passing the saw from above downward, making the primary incision below instead of above the pubis. Bumm advocates saw-

ing the bone near the symphysis. After the bone is divided the delivery may be spontaneous, by forceps, or by version. The limitations of the operation are the same as in symphyseotomy. It is only applicable in pelves with a conjugate diameter of 7 cm. or more. The necessary precautions about holding the limbs and preventing too wide a separation of the pelvis are the same as in symphyseotomy. The dangers of the operation are hemorrhage, laceration of the vagina, injury of the bladder, infection of both the wounds and the bone, and failure of bony union in the pubis. One hundred and forty-six operations are recorded with eight deaths (Kannegieser).

I would limit pubiotomy to cases in which the head is impacted low in the pelvis and in which there is insuperable obstruction from

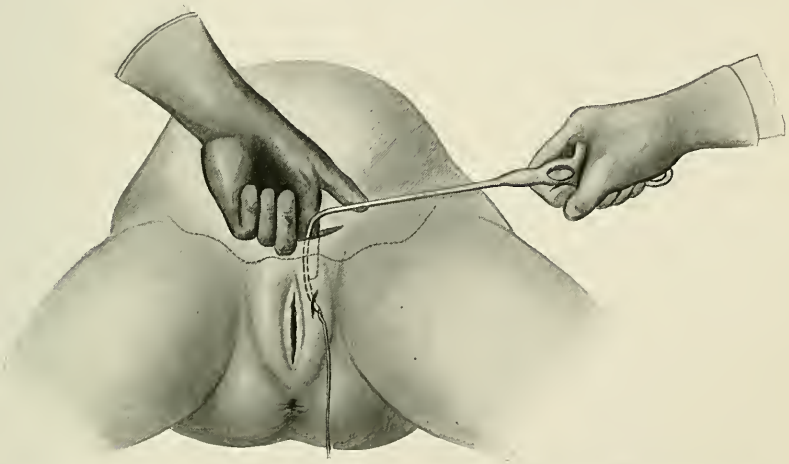


Fig. 678.—Insertion of the Doederlein needle and carrier to place the Gigli saw back of the pubis.

a contracted outlet, only discovered after labor has been in progress some time and when the os is fully dilated. In the author's judgment hebotomy will share the fate of symphyseotomy, as an alternative to Cesarean section, becoming obsolete as the results of Cesarean section steadily improve.[1]

CESAREAN SECTION[2]

If the child cannot traverse the pelvic canal, it may be delivered by an abdominal and uterine incision. Cesarean section may be performed ante- and postmortem.

[1] "Zentralbl. f. Gyn.," No. 45, 1904; "Amer. Jour. of Surgery," June, 1906.

[2] The name is not derived from Cæsar, but from the Latin description of the operation, *Cæso matris utero.*

Postmortem Cesarean Section.—If a pregnant woman near term dies suddenly, the abdomen and uterus may be cut open as quickly as possible, in order to deliver a living infant. It is said that the child has been extracted alive twenty minutes, three-quarters of an hour, and even two hours after the death of the mother, although it is almost inconceivable that this should be so. The child's death usually is synchronous with that of the mother, or follows a few moments afterward. In my opinion rapid version and extraction preceded by forcible dilatation of the cervix is a preferable method of delivery in a woman who has died suddenly during pregnancy, and, if possible, the operation should be completed before death has actually occurred. The tissues of the dying woman offer no resistance to the forcible dilatation of the cervix, and the extraction of the child can be effected, as a rule, quite as quickly by version as by Cesarean section.

Cesarean Section upon the Living Woman.—The first recorded Cesarean section upon a living subject was performed in Europe in the year 1610[1]; but the operation is probably a much older one, and was in all likelihood known in certain primitive tribes and nations in remote antiquity. Until quite recent times the mortality of Cesarean section was so high that the operation was avoided at any cost. Throughout the civilized world the mortality was at least 50 per cent. With the improvement in the operative and aseptic technic of abdominal surgery, the statistics of Cesarean section have steadily improved. Under favorable circumstances and in the hands of skilful operators, the mortality of Cesarean section should be below 5 per cent.

Varieties of the Cesarean Section.—In 1876 Porro[2] modified the operation by successfully performing, in addition to the celio-hysterotomy, a hysterectomy. The stump was fixed in the abdominal wound and treated extraperitoneally. The improvement introduced by Porro reduced the mortality one-half by the prevention of leakage through the uterine wound into the abdominal cavity.

The next improvement in the technic was introduced by Müller, who advocated a long abdominal incision through which the womb was delivered before it was incised. This prevented the soiling of the peritoneal cavity by liquor amnii and blood. Müller also advocated the application of an Esmarch tube around the cervix and broad ligaments to control hemorrhage, but this is a bad plan, as it predisposes to postpartum bleeding from

[1] By Trautmann in Wittemberg. The patient lived twenty-five days.

[2] The amputation of the uterus after a Cesarean section was first proposed by Michaelis in 1809, and first carried out with a fatal result by Storer, of Boston, in 1868.

relaxation of the womb, and is never really necessary. No constriction of the cervix at all is required if the operation is done with sufficient rapidity.

The most important modification of Cesarean section in recent times was introduced by Sänger,[1] who was the first to propose the careful and accurate closure of the uterine wound by a double layer of sutures. At first it was thought necessary to make a peritoneal flap by exsecting a portion of the uterine muscle below the peritoneum. But it was soon recognized that this is unnecessary, and the present practice is to use simply deep and superficial layers of sutures, sufficiently large in number to secure the accurate and firm closure of the uterine wound. A single insertion of the needle on each side of the wound insures the approximation and closure of the peritoneal covering of the wound.

Indications for Cesarean Section.—The indications for this operation are relative and absolute.

By an absolute indication is meant some condition which admits of no other method of delivery. Examples are furnished in extreme degrees of pelvic contraction—in a flat pelvis, for instance, in which the true conjugate is less than 6.5 cm. (2.56 in.). The highest grades of kyphosis, osteomalacia, spondylolisthesis, and Naegele's pelves also furnish absolute indications for Cesarean section, as do foreign growths obstructing the pelvis, cicatricial contraction of the vagina, and carcinoma of the cervix and of the rectum.

By a relative indication for Cesarean section is meant a condition that admits of some other method of delivery,—say, by pubiotomy, forceps, version, or by craniotomy,—but in which the question arises whether Ceserean section will not give the best result for mother and child. Examples of a relative indication for Cesarean section are found in flat pelves with a true conjugate above seven centimeters.

Technic of the Porro Operation or Celiohysterectomy.—The most favorable time for a Cesarean section is about two weeks before term. It is not necessary to wait for the beginning of labor; in fact, it is better not to do so if the indication for the operation is absolute. A time of day convenient to the physician should be selected, and all the preparations should be made for the operation as for any other abdominal section. In addition, there should be a painstaking cleansing of the vulva and vagina, and the latter should be packed with sterile gauze immediately before the abdominal section.

The Operation.—With a large scalpel held firmly in the full

[1] "Archiv f. Gyn.," Bd. xix.

hand, a free incision is made from two inches above the umbilicus to just above the symphysis. This incision may be carried entirely through the abdominal wall in its upper part, as the intestines are out of the way. The abdominal opening is enlarged with scissors downward as low as possible. An assistant makes the wound gape while the operator delivers the womb from the abdominal cavity. A large intestinal gauze pad is next packed in the peritoneal cavity behind the uterus, and two other gauze pads are packed between the uterus and the sides of the incision. The assistant then approximates the edges of the abdominal wound as closely as possible around and above the cervix, at the same time squeezing the latter with his outspread hands. With a few rapid but light strokes of the knife the operator makes an incision through the uterine muscle, but not through the membranes, long enough to permit the delivery of the child. Then, by the fingers of the left hand, the uterine wall is opened into the uterine cavity, the membranes are ruptured, the placenta, if in the way, is detached and pushed aside, the child is seized by the most accessible part,—shoulder or leg,—is delivered, and, with the placenta still attached to it, is dropped into a sterile sheet spread out over the outstretched arms of an assistant who stands directly at the operator's left hand, and whose duty it is to revive the child, if asphyxiated, and to tie and cut the cord. Up to this point the operation rarely requires seventy-five seconds. Then, if the Porro operation is performed, follows an easy hysterectomy: the ligation of the ovarian arteries and of the arteries of the round ligaments; the application of clamps; the cutting of the broad ligaments; the preparation of peritoneal flaps; amputation of the womb; the ligation of the uterine arteries; and the oversewing of the stump, which is dropped.

The technic of the Sänger operation is the same up to the point when the child and appendages have been extracted from the womb. Then, instead of amputating the uterus, the uterine wound is carefully brought together by three sets of sutures; one interrupted, of fine Pagenstecher thread, set about an inch apart, inserted under the peritoneum running across the lower part of the wound above the endometrium and emerging on the opposite side under the peritoneum; the second, a running catgut (chromicized) stitch in two tiers, embracing the muscle only and ending opposite the point where it began, so that there is but one knot; the third, a continuous stitch of catgut in the peritoneum, beginning above and running down, the needle being inclined upward at each insertion to allow for the pull downward of the suture when it is tightened, and coming back again to the top of the wound, making an interlacing suture (Figs. 679 and 680).

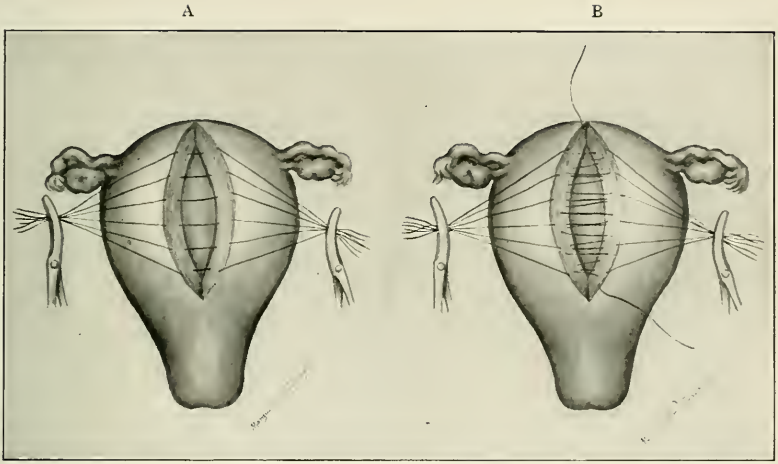


Fig. 679.—A, The interrupted sutures; B, the lower tier of the running catgut stitch.

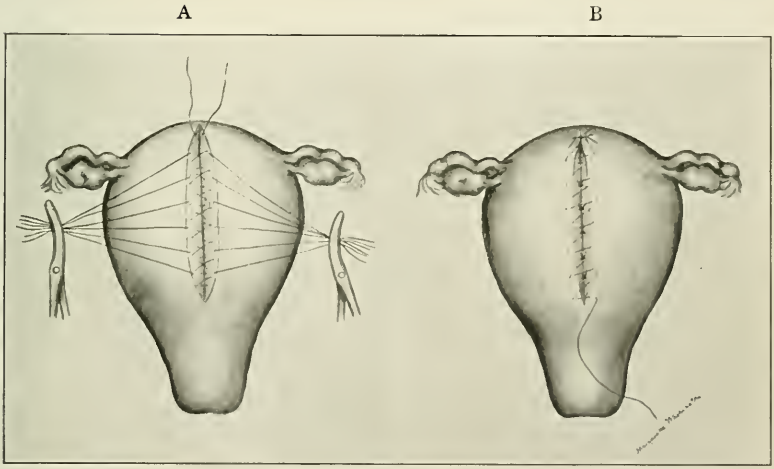


Fig. 680.—A, The upper tier of the running catgut stitch; B, the running stitch in the peritoneum, which goes up again to where it began, the needle being inserted between the punctures made coming down, and there being but one knot on the peritoneal surface above the upper angle of the wound. The completed stitch is like a shoe-lace.

Fritsch's proposition to make the incision across the fundus uteri from tube to tube, instead of in the anterior abdominal wall, has received a trial in Germany.[1] There is no decided advantage in it except that the uterine wound is as far as possible from the cervical canal, and, therefore, from subsequent contamination. It is also a little easier in the fundal incision to enucleate the uterine end of the tubes and thus to prevent future conceptions. But should leakage occur, the woman is deprived of a safeguard to which she has often owed her life, namely, adhesions between the uterine and abdominal walls, and the incision is made in that portion of the uterus most subject to spontaneous rupture in subsequent pregnancies. Therefore, the fundal incision is not recommended.

The Choice of Celiohysterectomy or of Celiohysterotomy in a Case Requiring Cesarean Section.—The classical conservative Cesarean section, or celiohysterotomy, is a safer and better operation than the Porro-Cesarean section, or celiohysterectomy—the removal of the uterus after the extraction of the child. Hysterectomy should only be performed when a woman has been very long in labor and many futile attempts to extract the child have been made, probably infecting the endometrium; if there is uncontrollable hemorrhage from uterine atony; in case of insuperable obstacle to drainage of the lochia, as a cancer of the cervix or a bony tumor of the pelvis; or in the presence of a uterine tumor which could only be removed with the uterus.

If Cesarean section is performed for a relative indication, and it is possible in future labors for the patient to be delivered without a repeated section, the Sänger operation is obviously indicated.

In view of the improved results of the operation, there is no objection to a repeated Cesarean section, so that it is not unjustifiable to allow a woman to become pregnant again, even with the certainty of a repeated section.[2]

The author's experience in Cesarean section amounts to 83 operations, performed for the following indications: fibroid tumors, 2; dermoid cysts impacted in pelvis, 2; cancer of the cervix, 1; partial atresia of vagina, 2; cornual pregnancy, 1; impacted shoulder presentation, 2; contracted pelves, 73, of which there were 2 kyphotic pelves, 2 obliquely contracted and flat, 1 trans-

[1] Hübl has collected 51 cases of fundal incision according to Fritsch's method, "Monatschr. f. Geb. u. Gyn.," Bd. x, p. 417. A case is reported as spontaneous rupture of the uterus in a subsequent pregnancy. (Ekstein, "Zentralbl. f. Gyn.," No. 44, 1904.)

[2] "Repeated Cesarean Sections," Haven and Young, "Am. Jour. of Obstetrics," October, 1903; also, "Annales de Gyn.," Oct., 1904, p. 577. In 175 operations in Schauta's Clinic there were 18 repeated sections. Neumann, "Arch. f. Gyn.," Bd. lxxix.

versely contracted, 2 justo-minor and 66 flat rachitic. Among this number it was necessary to perform a Porro operation in 14 cases. In 7 of the operations for contracted pelvis the patient had been in labor many hours. Futile attempts at delivery had been made with forceps, and in two instances by craniotomy. The uterus was already infected and the birth-canal injured by slipping instruments or by the exercise of unjustifiable force in efforts at extraction. In one of the cases of impacted dermoids the woman had been in labor four days. The pelvic connective tissue and lower uterine segment were extraordinarily edematous and the endometrium was almost black in color. In the two cases of fibroids attached to the lower uterine segment a hysterectomy was necessary to remove the tumors. In the cases of atresia of the vagina and of cancer of the cervix it was obviously improper to leave the womb behind.

It appears that a Porro operation is required in practice about one-sixth as often as the conservative Cesarean section.[1]

Extraperitoneal Cesarean Section.—Frank[2] has revived the old idea of Joerg and Ritgen, to make a transverse incision over the symphysis, to push up the peritoneal reduplication, and to incise the lower uterine segment below it. It remains to be seen if a better aseptic technic makes this operation justifiable. American surgeons who remember the results of laparo-elytrotomy will be loth to attempt it. The operation is only justifiable in case of long-continued labors with infection of the birth-canal. Personally I would prefer a Porro operation in such cases.

[1] Leopold in 100 Cesarean sections performed the Porro operation twenty-nine times; Ueber 100 Sectiones Cæsareæ, "Arch. f. Gyn.," Bd. lvi.

[2] "Zentralbl. f. Gyn.," No. 36, 1906.

CHAPTER III

Operations for the Complications and the Pathological Consequences of the Child-bearing Process

THE preparation of the patient and the room has already been described. The dressings in the autoclave in hospital work are as follows:

Dressings and the Packing of the Autoclaves.—The cage of one autoclave is packed from the bottom up with the following materials in regular order for an abdominal section:

Packing Cage for Autoclave No. 1.—Four pieces absorbent cotton; 12 pieces of gauze; 1 book of silver foil; 12 towels; 2 tubes of Pagenstecher's thread; 1 glass tube filled with 6-inch gauze bandage for packing; also a 3-inch rolled bandage; 4 sheets; 3 gowns; 3 caps, or squares of gauze for the head; 3 nail-brushes. This cage is subjected to three sterilizations on three successive days. A cage is always kept packed that has had two sterilizations at 240° F. for forty minutes for emergency operations. It is again sterilized immediately before the operation.

The second autoclave without a cage is packed from within outward, as follows:

Autoclave No. 2.—Three small basins; 1 package, wrapped in gauze, containing 15 pads for sponges;[1] 3 large abdominal pads with tape on the corner; 1 dozen butterfly 8-ounce sponges; 1 pan for sutures and needles; 2 small white enameled pitchers; 1 tube of catgut; 3 nail-brushes; small jar of olive oil for Downes's clamps; 2 rubber sheets to cover the glass table with.

The gauze pads are provided in an invariable number. By using an invariable number the nurse who prepares the package has no excuse for a mistake in this respect, and by making this number as small as practicable, time and trouble are saved in the final count of the pads.

For a plastic operation the following articles are omitted from the autoclaves: From No. 1, the abdominal binder, tubes of silk, pieces of gauze, and the silver foil; a fenestrated sheet is added. From No. 2, the gauze pads. For plastic operations sea sponges are preferable and are safe if soaked over night in a 1:1000 sublimate solution. They are used once only.

[1] These packages of pads have had two previous sterilizations and are kept stored in sterile glass jars.

Fig. 681.—Protection of field of operation by sterile towels.

Fig. 682.—A sheet of rubber dam over the buttocks tied with tape to the uprights of the table, with a slit corresponding with the vulvar orifice.

In private-house operations the patient is given a list of the articles to provide as follows:

For Plastic Operations.—One 250-gram can Squibb's ether (unopened); 1 pint alcohol; 8 ounces tincture of green soap; 1 pound absorbent cotton; 5 square yards sterilized gauze; 3 small sea sponges (size of lemon), to be soaked over night in a 1:1000 bichlorid solution; 1 bottle bichlorid tablets; 1 square yard iodoform gauze (5 per cent.).

For Abdominal Section.—One 250-gram can Squibb's ether (unopened); 1 quart alcohol; 1 pint tincture green soap; 1 pint benzine; 1 quart 1 per cent. formalin; 1 bottle bichlorid tablets; 4 ounces collodion; 2 ounces carbolic acid (pure); 1 roll 3-inch Z. O. adhesive plaster; 1 pound absorbent cotton; 5 square yards sterilized gauze. If plastic also, add 1 square yard iodoform gauze (5 per cent.) and 3 small sea sponges, soaked over night in a 1:1000 bichlorid solution.

The operator carries, in addition to his instruments, a bag containing the following articles: Nest of 6 basins, sterilized; 4 brushes, sterilized; 6 pair of gloves, sterilized; douche bag, sterilized; 4-ounce bottle of sterilized glycerin; 4-ounce bottle of sterilized alcohol; 1 sterilized razor; 1 bottle of sterilized normal salt tablets; bag of cotton balls; chloroform mask; bottle of chloral chloroform; small can of ether; 3 ounces of collodion; 3-ounce bottle of pure carbolic acid; 1 square yard of iodoform gauze (unopened); 1 bottle of bichlorid tablets; 1 sterile hypodermoclysis needle.

For all vaginal operations the patient is arranged in the dorsal position, with the legs covered by sterilized leggings, supported by Edebohls' leg supports. The field of operation is either surrounded by sterile towels (Fig. 681) or protected by rubber dam (Fig. 682).

Operations on the vulva are for perineovaginal fistula; vaginismus; imperforate or resisting hymen; agglutination of the labia; exsection of the five pairs of vulvar nerves; exsection of neoplasms.

Perineovaginal fistula, the result of a central tear or perforation of the perineum, is treated by inserting a scissors blade in the sinus, slitting the perineum into the vagina, denuding the granulations along the sinus tract, and uniting the wound with sutures.

Vaginismus, a possible cause of sterility, if it does not yield to gradual dilatation or to the electrocauterization of painful papillæ, is treated by incising the perineal body and carrying the incisions up to the posterior vaginal sulci, in imitation of the commonest form of laceration in labor. Interrupted sutures unite skin and mucous membrane, but do not include muscle or fascia.

Imperforate or resisting hymen requires exsection of the hymen

by cutting it with scissors around its base. The narrow wound left is closed with interrupted catgut sutures.

Agglutination of the labia is usually seen only in young infants, but may persist to adult life. A blunt dissection separates the labia. If a raw surface remains it is covered by suturing, or else

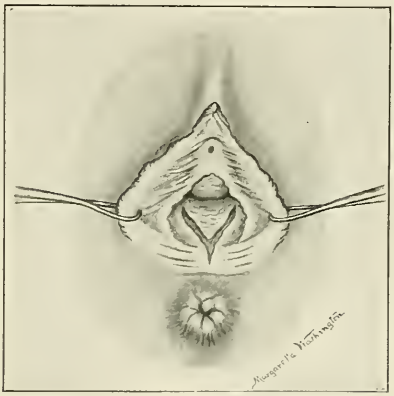


Fig. 683.—Y-shaped incision through the levator ani muscles and the perineum for vaginismus.

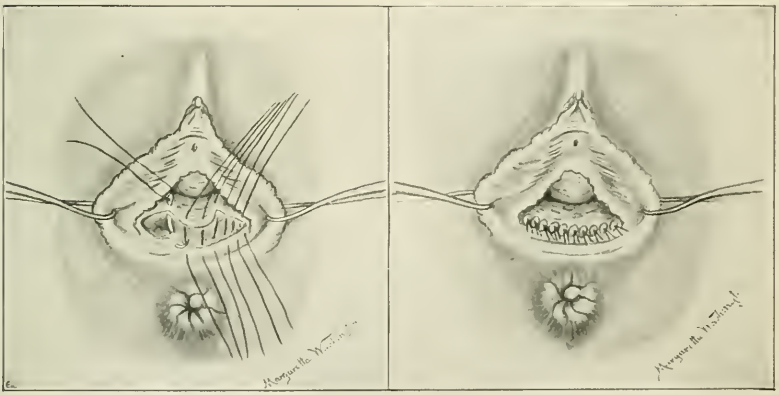


Fig. 684.—Insertion of the sutures in the operation for vaginismus.

a light pack keeps the labia apart till the abraded surfaces are healed (Fig. 685).

Exsection of the vulvar nerves is required in the worst cases of pruritis resisting all other treatment. Four incisions are made: two parallel with the ascending ramus of the ischium, two over Poupart's ligament. Through the first the long pudendal nerves are exsected, as large a segment as possible being pulled out.

After opening the triangular ligament, the terminal branches of the pudic, the perineal nerve, and the nerve of the dorsum of the clitoris are removed. Through the second incision the genitocrural and the ilio-inguinal nerves are removed.

Fig. 685.—Agglutinated labia in infant: 1, Before separation; 2, afterward.

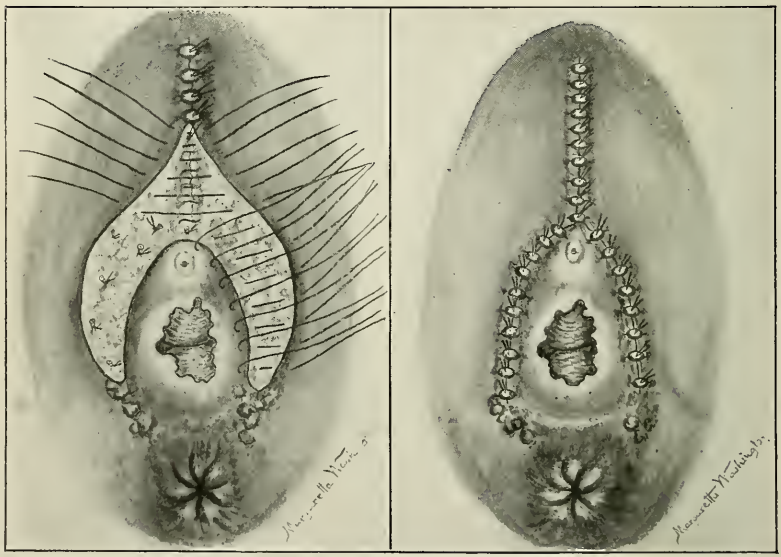


Fig. 686.—Steps in operation for elephantiasis.

Amputation of the labia and clitoris; removal of the inguinal glands is required for the removal of malignant growths. The incisions and closure of the wounds are shown in Fig. 686.

The same technic, without the inguinal section, is required for

elephantiasis vulvæ. The removal of polypoid and sessile tumors of the vulva present no difficulties, as a rule, though control of the hemorrhage in the latter, if large, may be awkward.

Operations on the vagina are required for lacerations of the posterior wall, including the perineum, possibly the sphincter ani and the rectovaginal septum; rectovaginal fistulæ; lacerations and injuries of the anterior wall, including urinary fistulæ; for acquired stenosis and atresia of the vagina; vaginal sections for opening the vaults.

Lacerations of the posterior wall, like all the lacerations of the genital canal, are best repaired a week after labor, under an anesthetic, on an operating table, with sufficient assistance and implements, exactly as in a secondary operation: The labia are seized with Allis' forceps at the level of the lowest carunculæ myrtiformes. A guide stitch is placed in the posterior vaginal wall directly under the external urinary meatus. By pulling one Allis forceps and the guide stitch in opposite directions outward and downward, the posterior sulcus is exposed; denudation is required, even in a recent tear, for a part of it is always submucous. The other sulcus is exposed and denuded. Then by holding the guide stitch upward in the middle line and pulling the forceps apart the mucous membrane between the sulci is denuded or freshly torn surfaces covered with granulation-tissue are scraped with the edge of a knife. The ruptured levator ani muscle in the posterior sulci is united with a double tier suture of chromic gut, two half-hitches being taken in the stitch as it turns upward after coming down from the apex of the wound, in its deeper portion to the base. One knot at the apex of the sulcal denudation secures the stitch. The retracted ends of the transversus perinei and bulbocavernosus muscles are brought together by silkworm sutures, which are inserted by the technic represented in Fig. 693. Finally, a single stitch at the top of the perineal wound unites the posterior commissure of the vulva, restoring the fossa navicularis. The perineal stitches are knotted; they are removed on the twelfth day.

If the operator prefers the older method of an immediate operation the sutures may be inserted as represented in Figs. 695–699. This method, however, does not give as good results in the repair of the genital canal as the intermediate operation at the end of a week.

Lacerations of the sphincter ani can be successfully repaired almost without exception by the following technic. Any one who must confess to as much as 5 per cent. failures has not yet learned how to perform the operation:

The sphincter ani is seized between the forefinger and thumb of both hands and thoroughly stretched. The denudation is made so as to expose the retracted ends of the muscle. Two good-

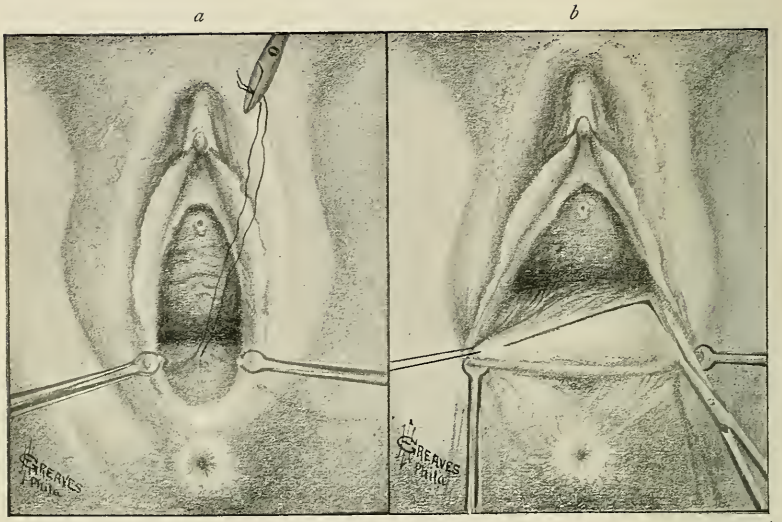


Fig. 687.—The Emmet operation: *a*, The guide suture on the crest of the rectocele and the forceps at the level of the lowermost carunculæ myrtiformes; *b*, marking with scissors the area to be denuded in the left sulcus.

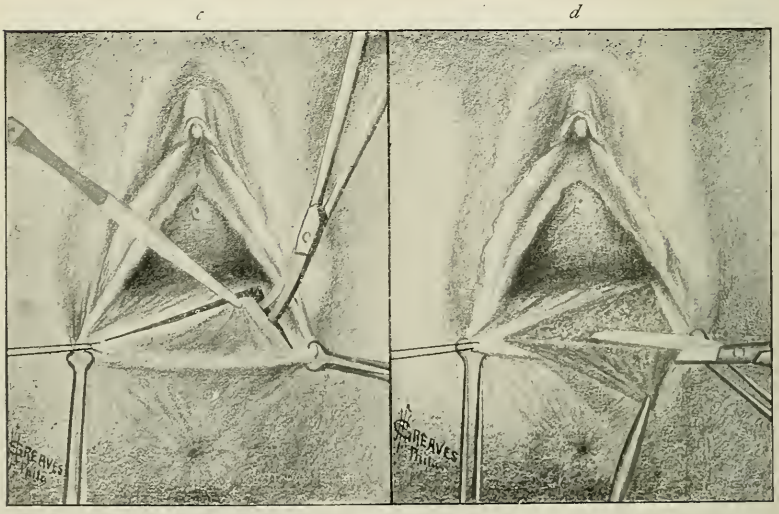


Fig. 688.—The Emmet operation: *c*, Denuding the left sulcus; *d*, cutting off the flap of vaginal wall made by denuding the left sulcus.

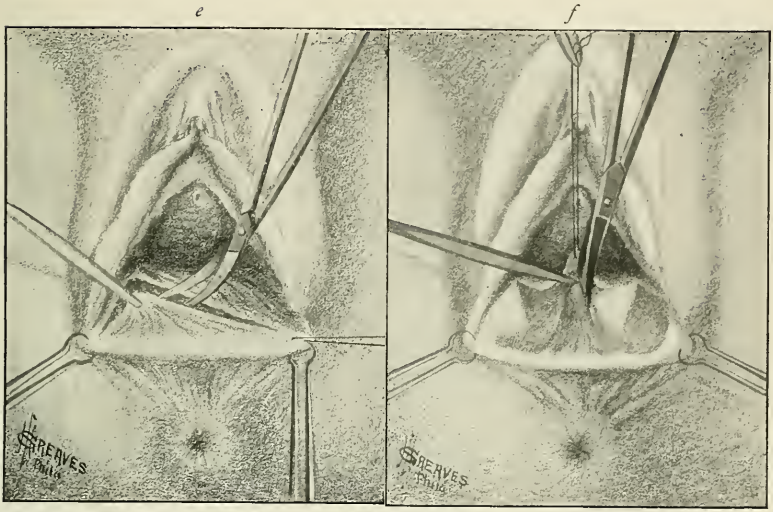


Fig. 689.—The Emmet operation: *e*, Denuding the right sulcus; *f*, denuding the triangular area between the sulci.

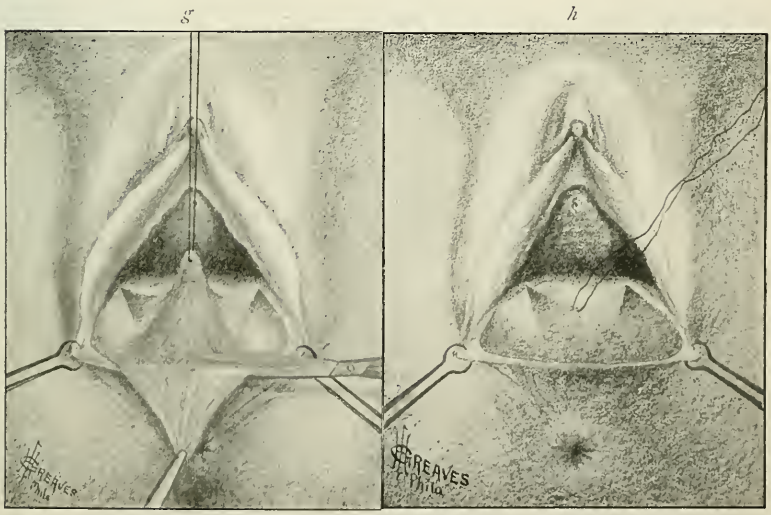


Fig. 690.—The Emmet operation: *g*, Dissecting and removing the third triangular flap from the crest of the rectocele to the base of the perineal tear; *h*, the denudation completed.

sized tenacula are hooked deeply in the muscle and its ends are brought into plain sight. They are easily recognized, being a

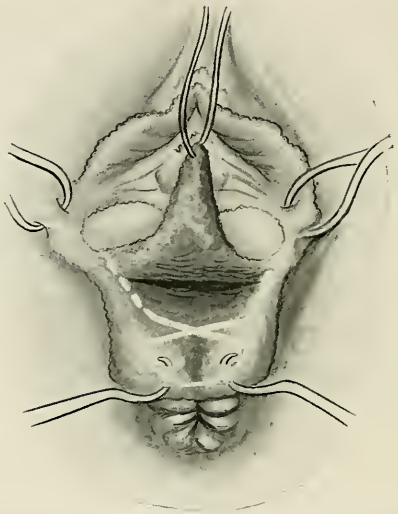


Fig. 691.—Figure-of-eight suture for the sphincter ani in complete lacerations of the perineum.

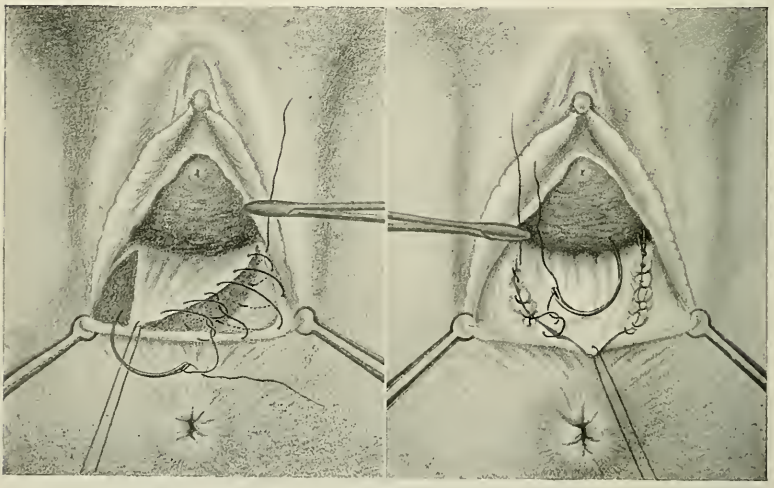


Fig. 692.—The Emmet operation : Continuous two-tier suture of the posterior sulcus for lacerations of the levator ani muscle.

lighter, yellowish red, contrasted with the deep red of the tissues around them. Two or at most three figure-of-eight stitches of silkworm gut are inserted, begininng and ending in the vagina.

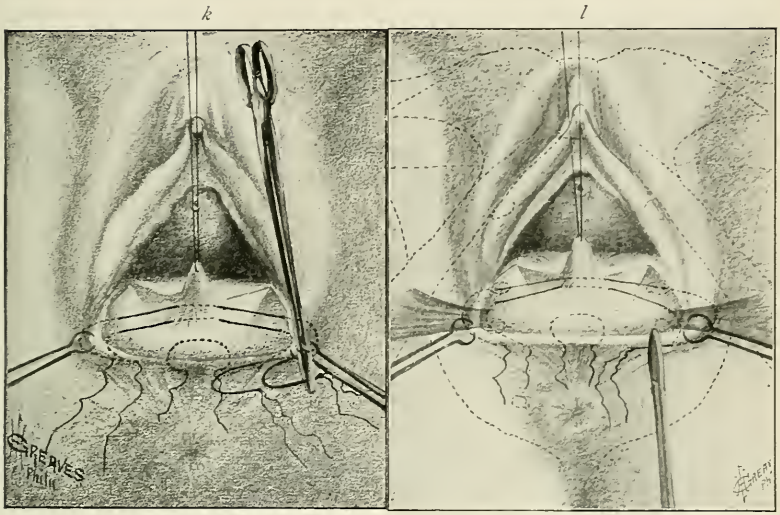


Fig. 693.—The Emmet operation: *k*, The insertion of the crown stitches by a back-handed stroke on the right side which catches the retracted end of the transversus perinei muscle; *l*, by forcible traction on the edges of the vulvar wound the needle catches more firmly the retracted ends of the transversus perinei muscles and the stitch is continued in the usual manner from right to left.

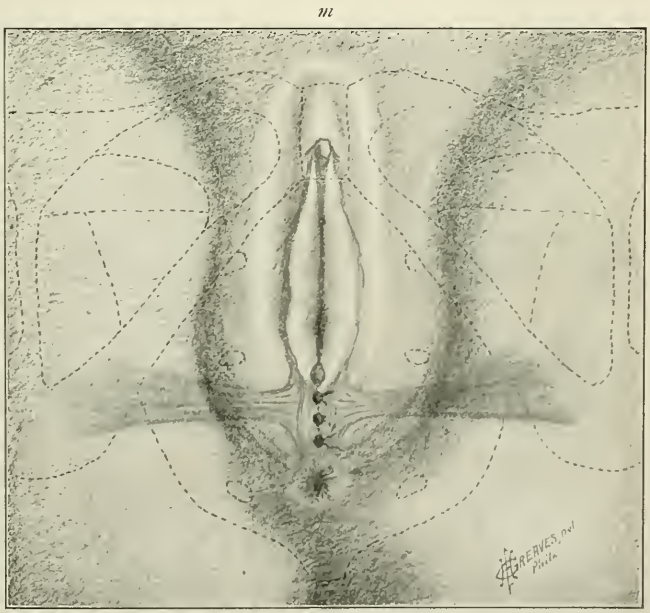


Fig. 694.—The Emmet operation: Perineal sutures joining the transverse perineal muscles and the perineal body in the middle line.

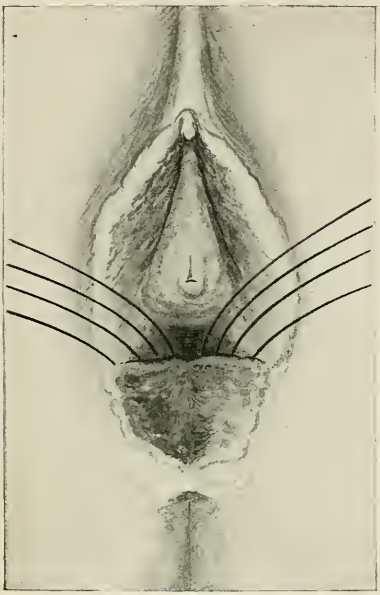


Fig. 695.—Vaginal sutures for the repair of a laceration through the perineal body.

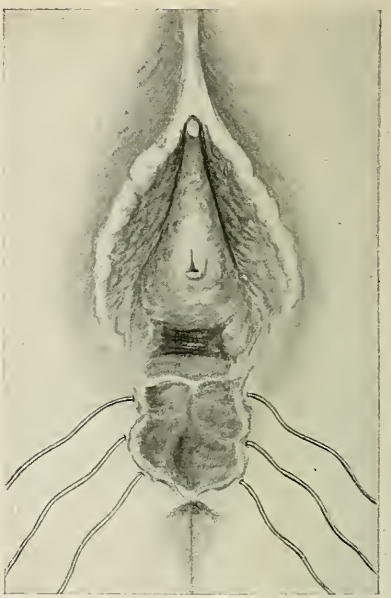


Fig. 696.—Perineal sutures for laceration of the perineal body.

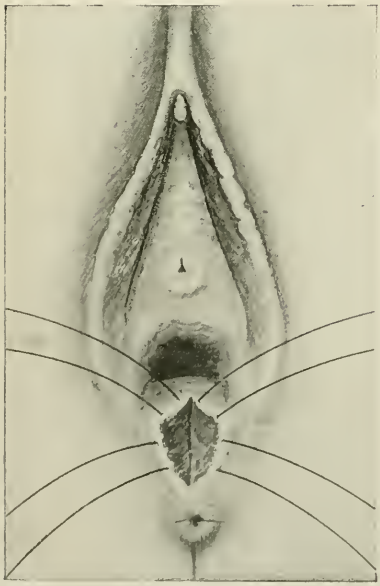


Fig. 697.—Vaginal and perineal sutures for laceration of the perineal body.

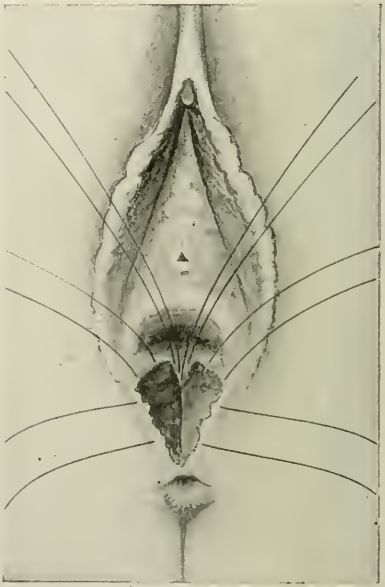


Fig. 698.—Vaginal and perineal sutures for laceration of the posterior vaginal sulci and of the perineal body.

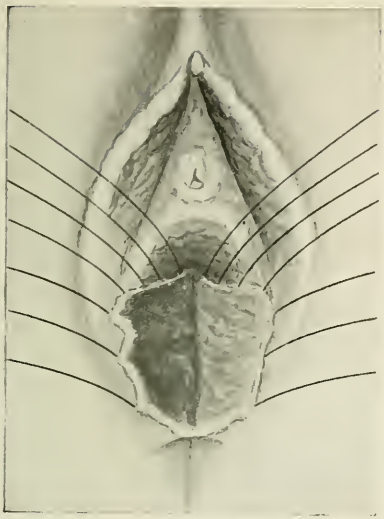


Fig. 699.—Vaginal and perineal sutures for an extensive tear involving the whole length of the perineum down to the anus.

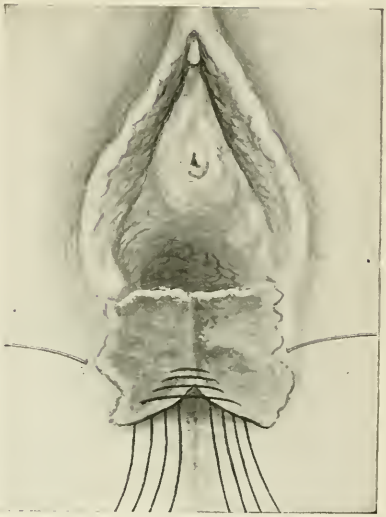


Fig. 700.—Rectal and anal sutures in a complete tear of the perineum.

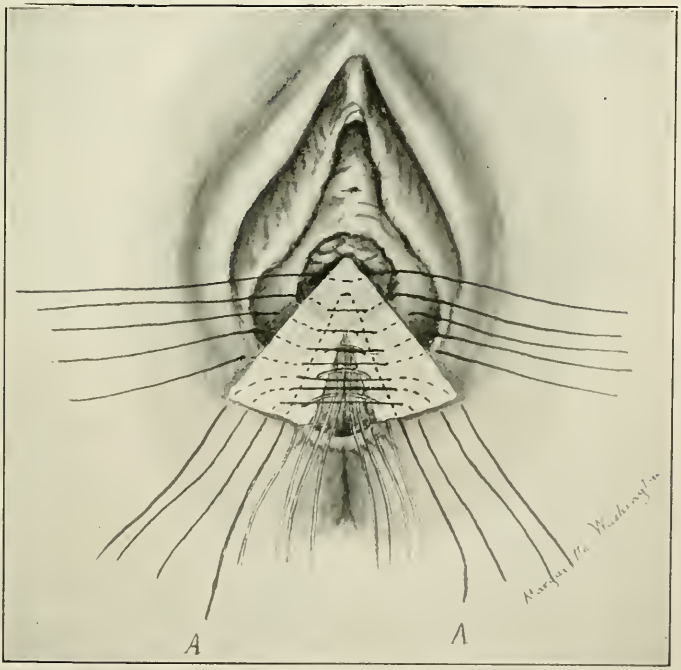


Fig. 701.—The sutures for a complete laceration of the perineum in either a primary or a secondary operation : A, A, the barrier or splint stitch.

In the turn that catches the muscle a deep insertion is made. These stitches are shotted in the vagina. The remainder of the perineal or pelvic floor laceration is repaired as usual. The advantage of the figure-of-eight stitch is that the sutures are more easily removed. They may, however, be inserted from the rectal side and knotted in the rectum, with a greater certainty of permanent union. The bowels are kept fluid for two weeks by Carlsbad water and Sprudel salts. The stitches are removed on the fourteenth day.

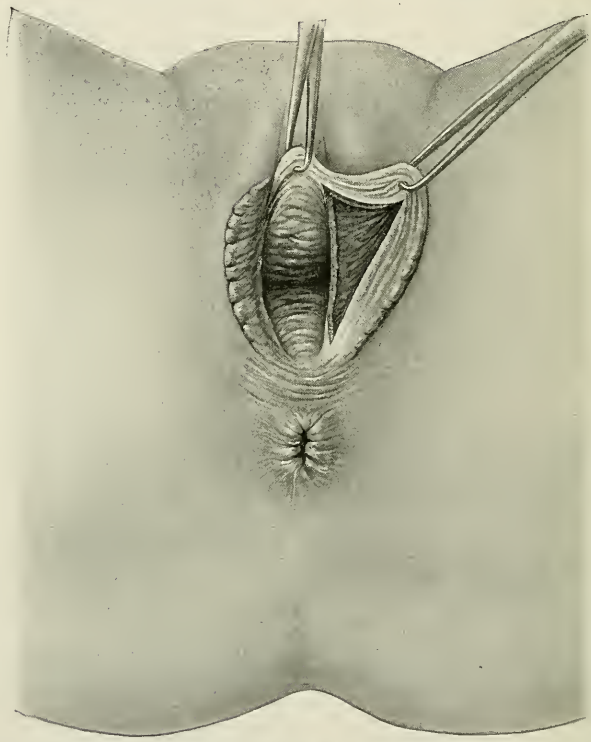


Fig. 702.—Denudation of the anterior vaginal sulcus for submucous laceration of the muscle and fascia of the urogenital trigonum.

If the *rectovaginal septum is torn*, it is united after a flap-splitting denudation by a two-tier suture of chromic gut, beginning and ending in the vagina.

Lacerations of the anterior vaginal wall occur in the anterior vaginal sulci, involving the muscle and fascia of the urogenital trigonum, the only support of the lower third of the anterior vaginal wall. They are repaired by a triangular denudation, for they are almost always submucous, and a two-tier chromic gut suture (Figs.

702, 703). If these injuries are neglected and a cystocele results, two other factors must be taken into account in the damage sustained by the anterior vaginal wall in labor: the separation of the fascial plates under the vaginal wall and the pull of the uterovesical ligament on the bladder. The cystocele may be permanently cured by the following technic: A T-shaped incision through the vaginal wall and dissection of the flaps exposes the bladder, which is completely separated from the vagina by Goffe's dissector. The utero-

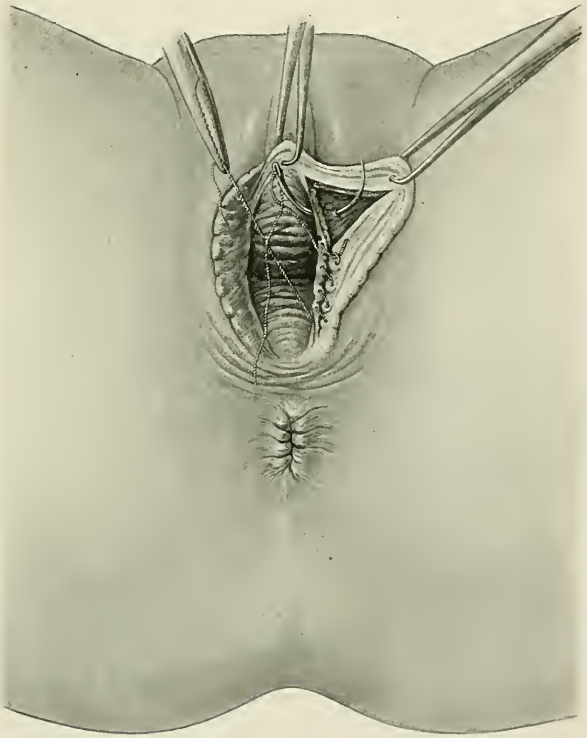


Fig. 703.—Junction of the urogenital trigonum muscle by a two-tier catgut suture.

vesical ligament is cut. The bladder is pushed up into the pelvis. The strong fascial plates are caught by curved needles and brought together in the middle line by mattress sutures of chromic gut, each insertion of the needle being from above downward. The vaginal wall is united by interrupted sutures, but is not relied upon for support. A formal cystocele operation may be performed two weeks after childbirth (Figs. 704–709).

Fistulæ between the genital and urinary canals are usually

the result of pressure-necroses following labor. They are becoming very rare in all civilized countries in which women receive proper attention in parturition. It is a question whether more are not encountered to-day from injuries in gynecologic operations, especially in hysterectomy for cancer of the cervix.[1] A neglected pessary sometimes ulcerates through the vesicovaginal septum. Other causes are fractured pelvis, injury of the vagina in attempts at criminal abortion, ulcerations through the vaginal wall of a vesi-

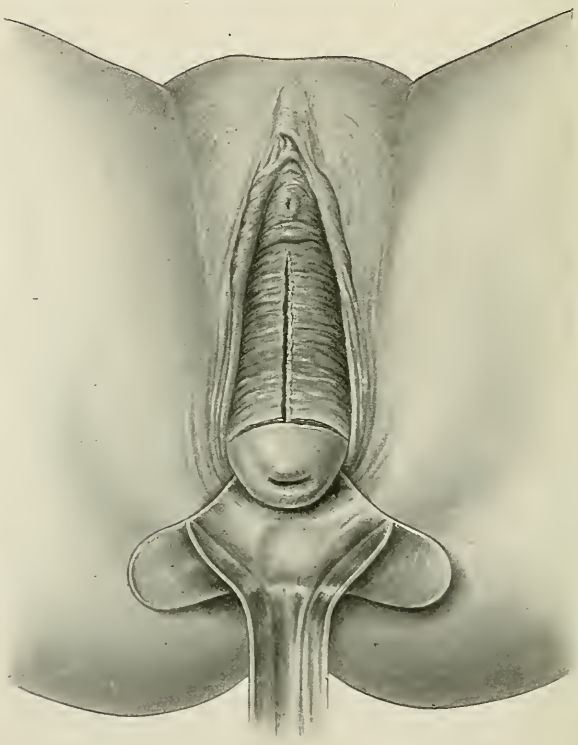


Fig. 704.—Operation for cystocele. Incision in anterior vaginal wall.

cal calculus or of a foreign body inserted in the bladder, injury to the bladder-wall in anterior vaginal fixation of the uterus, anterior colporrhaphy, symphysiotomy, pubiotomy, or myomectomy, and in obstetrical operations, such as the use of blunt hooks, attempts at version, clumsy insertion of the forceps, forcible extraction of the head past a prolapsed cystocele, and craniotomy.

[1] In the beginning of my practice I saw several vesicovaginal fistulæ a year following labor. Now I see about one a year.

The fistulæ following pressure-necroses in a prolonged labor are easily avoidable by the proper and timely use of the forceps or by the other obstetric operations that may be indicated in an insuperably obstructed labor. In more than 15,000 women delivered in the hospital services with which the author is connected there has not been a single urinary fistula following labor,

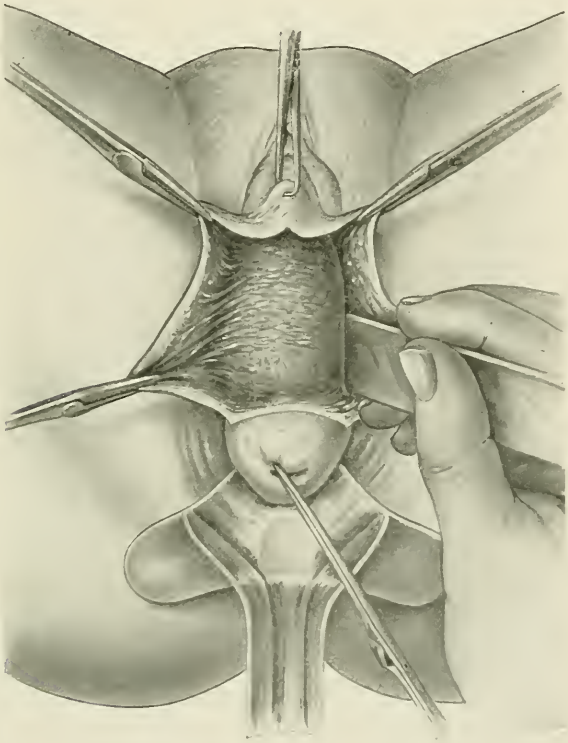


Fig. 705.—Separating bladder from vagina with Goffe's dissector.

but a few are referred to his clinics from year to year, delivered elsewhere.

Urinary fistulæ may be classified as follows: vesicovaginal fistulæ; vesicovestibular fistulæ, uterovesicovaginal fistulæ—(*a*) superficial, through the anterior lip of the cervix, which forms the upper wall of the sinus, and (*b*) deep, through the uterine wall, the anterior lip of the cervix having sloughed off; uterovesical fistulæ; urethral fistulæ; enterovesical fistulæ; colovesical fistulæ; ureterovaginal and uretero-uterine fistulæ.

The opening into the bladder varies in size and shape from a

pin-point orifice to a defect of the whole base of the bladder, and from a round hole, regular, as if punched out with an instrument, to a jagged opening usually running across the vagina, with offshoots running up the anterior sulci or in the median line. The vesical mucous membrane may prolapse through a large opening.

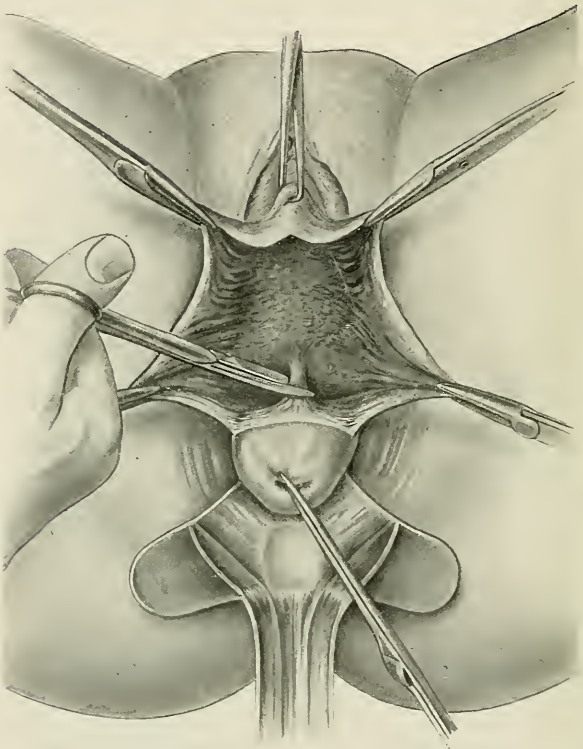


Fig. 706.—Cutting the uterovesical ligament.

Irritated by discharges and attrition, it becomes hypertrophied and inflamed.

The urethra is often wanting in its upper part and its canal may be obliterated.

Uterovesical fistulæ are usually situated in the anterior lip of the cervix, near the internal os. They are usually on the left side of the median line and are small in caliber.

Enterovesical fistulæ are exceedingly rare. Fritsch,[1] in his enormous experience, has seen but a single case.

[1] Fritsch operated on 200 urinary fistulæ in ten years ("Handbuch der Gyn.," vol. ii, p. 84).

Colovesical fistulæ are more common. They are usually the result of a pelvic abscess which opens both into the bowel and into the bladder.

Ureteral fistulæ more frequently follow gynecologic operations than labor. They are naturally small in size and are usually situated in the vaginal vault, though they may empty into the uterus.

Diagnosis.—It is usually easy to recognize a vesicovaginal fistula. There is incontinence of urine, and the orifice in the

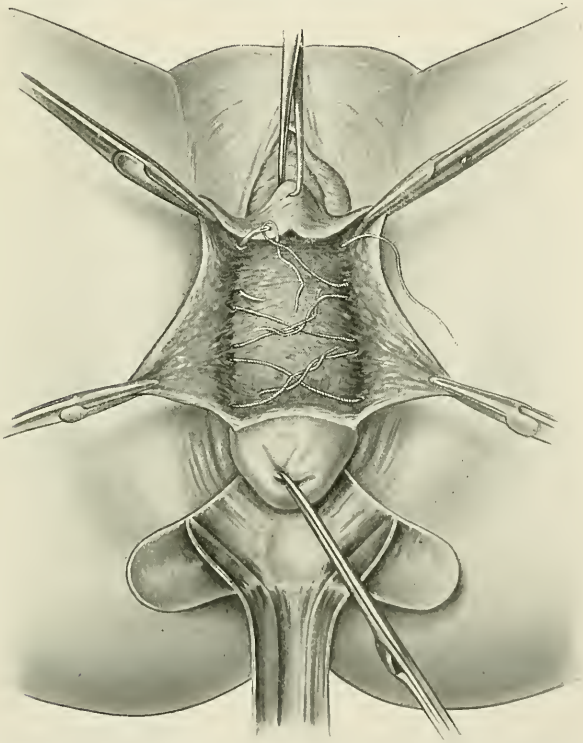


Fig. 707.—Figure-of-eight sutures to bring together the lateral fascial plates under the anterior vaginal wall.

vesicovaginal septum is visible by the aid of a Sims speculum. If the fistula is small, a uterine sound introduced in the bladder may be made to emerge from the orifice in the vagina, or the sound being held in the bladder, a surgeon's probe may be inserted into every suspicious-looking depresion in the anterior vaginal wall until the communication is discovered and the two instruments grate on one another. Colored fluid (a weak permanganate solution, methylene-blue, or sterilized milk) may be in-

jected in the bladder and will be seen oozing out of a small opening on the anterior vaginal wall.

A cervical fistula may be detected on inspection: separating the lips of the cervix, the tip of an intravesical sound is projected into the cervical canal; or, injecting the bladder with colored fluid, it flows out of the cervix, which is exposed by a bivalve vaginal speculum.

A ureteral fistula may be recognized by the fact that part of the urine is voided naturally, while part constantly dribbles away;

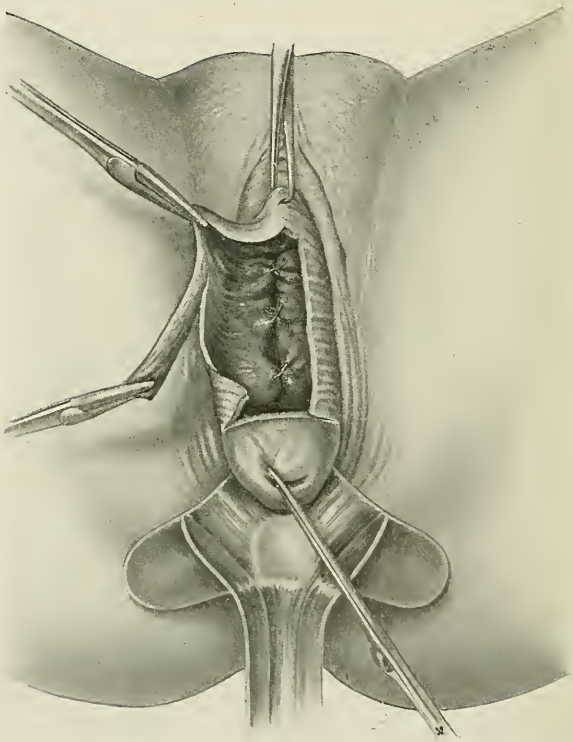


Fig. 708.—Lateral fascial plates united and redundant vaginal wall excised.

by sounding with a metal ureteral catheter every little indentation in the vaginal vault or cervical canal until the ureter is catheterized and the urine flows from the lower end of the catheter drop by drop or by injecting methylene-blue hypodermatically, draining the bladder with a rubber tube, and packing the vagina tightly with gauze. If there is a ureteral fistula the deepest portion of the packing will be most intensely stained.

An enterovesical or a colovesical fistula is recognized by a

microscopic examination of the urine, which shows food particles and feces. "A fecal odor to the urine is not always present and does not always denote a communication with the bowel" (Fritsch). An ingenious method of diagnosticating these fistulæ was demonstrated by Noble after Senn had discovered the hydrogen gas test for fecal fistulæ. A catheter was inserted in the urethra, the bowel was inflated with hydrogen, and the gas was ignited as it escaped from the end of the catheter.

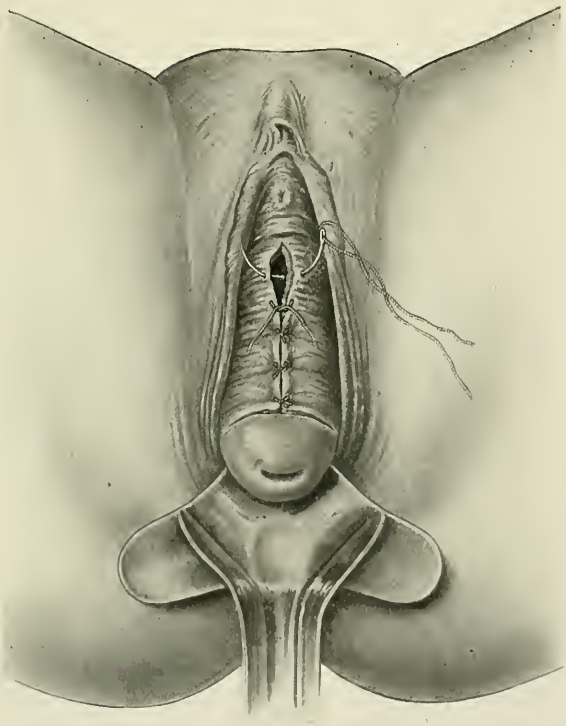


Fig. 709.—Vaginal walls united with interrupted sutures.

Treatment.—There is always a chance of a vesicovaginal fistula healing spontaneously. There are three methods by which a spontaneous cure is effected: First, by granulation tissue filling the opening and eventually closing it. This result is favored by irrigation of the vagina to keep it clean, by draining the bladder after the fifth day postpartum with a catheter or rubber tube, and by touching the edges of the fistula with a little nitric acid to promote exuberant granulation, although the application of the caustic had better be omitted if the case is apparently pursuing a favorable

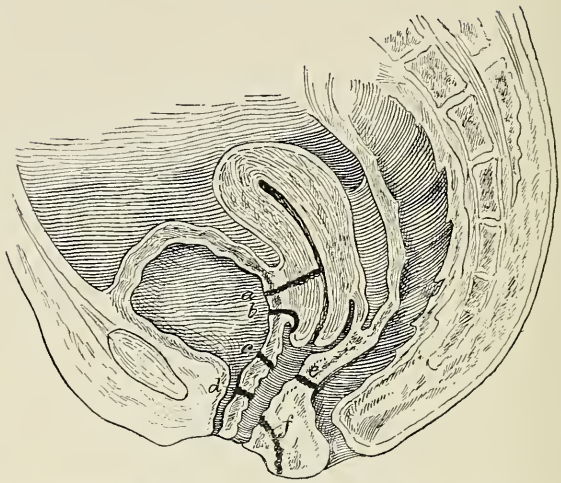


Fig. 710.—Fistulæ of the genital organs: *a*, Vesico-uterine fistula; *b*, vesico-cervical fistula; *c*, vesicovaginal fistula; *d*, urethrovaginal fistula; *e*, rectovaginal fistula; *f*, perineovaginal fistula (Beigel).

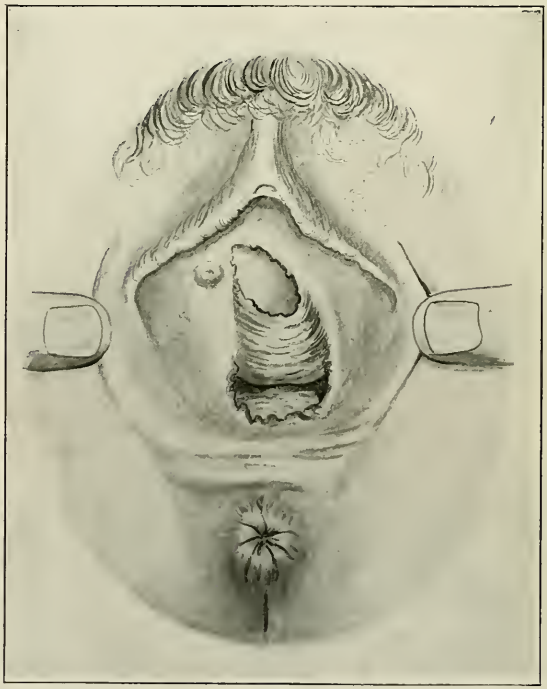


Fig. 711.—Vesicovaginal fistula.

course. Second, by an inflammatory infiltration and swelling of the vaginal walls, which approximate the edges of the fistula and keep them close together until union is secured. Third, by cicatrization, which in the course of three months may close an opening as large as a silver dollar.

The *operative treatment* should be postponed until at least a month after labor, to allow for the chance of spontaneous closure, to obtain firmer tissue for the plastic surgery, and to secure contraction of the fistula.

The vagina, bladder, and vulva should be rendered as healthy as possible by sitz-baths and irrigations with boracic acid and weak permanganate solutions. If the fistula is caused by a foreign body, such as an embedded pessary or a stone, sufficient time must be allowed after its removal to secure a complete healing over of ulcerated surfaces and a cessation of purulent discharge.

General anesthesia is usually required. Local anesthesia is not to be recommended.

The dorsal position, with raised buttocks and limbs fixed in leg-holders and stirrups, is most suitable for the majority of cases. In fistulæ deep within the genital canal, Sims's position or the knee-chest posture may be necessary. For the latter a specially constructed wedge-shaped cushion is the most convenient and safest support. Sims's specula with blades of varying length and breadth and lateral vaginal retractors; scissors, curved on the flat, sharp pointed, with thin blades; knives set at an angle on the shaft, as well as an ordinary narrow-bladed scalpel; bullet-forceps; two Ulrich tenacula and single tenacula; a rat-toothed tissue forceps; a needle-holder and assorted needles, most of which should be full curved, round-pointed, and delicate, and some of which should have the fish-hook curve, are the instruments required.

Fig. 712.—Ulrich's tenaculum.

The suture material should be silkworm gut, formalin catgut, and fine silk. The last is recommended most highly by Fritsch, whose experience with these operations is greater than that of any other surgeon. The field of operation is exposed by pulling down the cervix with a strong silk ligature, transfixing its lips at a sufficient height above the external os to prevent the ligature cutting out (1 centimeter), by vaginal retractors or by fixing the labia with bullet-forceps and pulling them apart. It is occasionally necessary to dilate the vaginal canal narrowed by cicatrization, and to cut, stretch, or tear cicatricial bands obstructing access to the fistula.

The shape and extent of the denudation are governed by the situation and extent of the fistula. The length of the wound should, if possible, run across the vagina, as the vaginal walls are more easily approximated from above downward than transversely. For small fistulæ a long linear incision having the fistula as its midpoint, with a broad denuded surface secured by a flap-splitting dissection, is the best. For larger fistulæ the denudation represented in Figs. 714 and 715 is preferable. The breadth of the denudation should never be less than 1 to 2 centimeters. If one edge of the fistula is adherent to the pubis or so fixed by cicatrices that it is immobile, a thick flap may be prepared from the vaginal

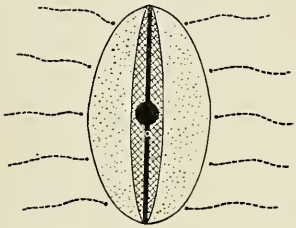


Fig. 713.—Denudation for a small fistula (Fritsch).

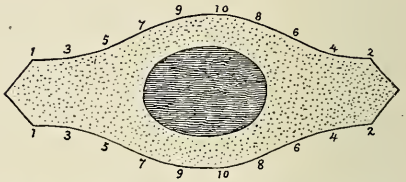


Fig. 714.—Denudation for fistula with tension on the edges of the wound (Fritsch).

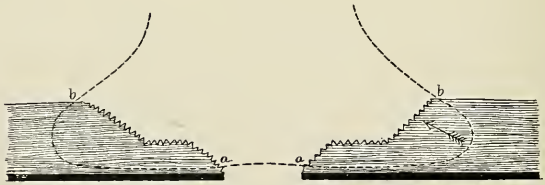


Fig. 715.—Insertion of the suture after the denudation: *a*, *a*, Suture just above the vesical mucosa; *b*, *b*, suture emerging in the vagina (Fritsch).

wall with a broad base, with the least torsion of the pedicle possible, and larger in all its dimensions than the denuded surface it is designed to cover. The flap is fixed by buried sutures of fine catgut, the edges of the mucous membrane being united by superficial stitches of silk or silkworm gut. A flap may be prepared by a semicircular incision with its base alonside the fistula; it is turned on its base so that the vaginal mucous surface projects into the bladder; after the edges are fixed by fine catgut in the denuded edges of the fistula, the raw surface is covered by the approximation of the vaginal mucous membrane surrounding it (Martin).

Ferguson proposes a circular incision around the fistula 3 to 6 mm. from its margin, down to the vesical wall. The vaginal flap is dissected loose, turned inward, and its free edges united

with fine formalin gut, thus closing the fistula. The raw surfaces left in the vagina are approximated by interrupted sutures.

It may be impracticable to close a large, irregularly shaped fistula at one sitting. The most easily approximated edges are united at one operation and the remainder of the opening is closed subsequently.

The anterior lip of the cervix may be used as a plug to cover in a considerable defect in the bladder wall. The author has thus closed a fistula admitting four fingers, due to the ulceration of a neglected pessary through the vesicovaginal septum. The lateral extremities of the fistula were closed in the ordinary way and the denuded vaginal portion of the cervix was fastened in the center of the wound, where a defect existed too extensive to be covered by vaginal flaps.

In closing fistulæ extending a considerable distance transversely, care must be exercised to locate the ureteral orifices, which otherwise might be buried in the denuded surface or occluded by a suture.

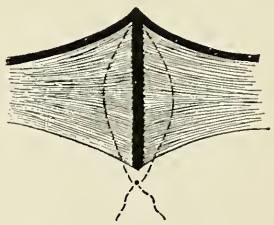


Fig. 716.—Apposition when the denudation is properly made and the suture correctly inserted (Fritsch).

In suturing a denuded area around or a transplanted flap over a vesical fistula, the needle must not penetrate the vesical mucous membrane. If it does, an intravesical hemorrhage will probably result in a failure of the operation or the suture tract may develop into another fistula. Acquired atresia of the vagina is a method of spontaneous cure not infrequently seen. If the patient has passed the menopause, she remains comfortable; but if she menstruates into the bladder, there may be severe distress at the periods;[1] and if the lower portion only of the vaginal canal is closed, a sac exists beneath the level of the fistula in which blood, pus, and decomposed urine collect. It is occasionally impossible to close a serious defect in the posterior wall and base of the bladder. In such cases a *colpocleisis* is justifiable, if the precaution is taken to close the canal up to the level of the fistula, leaving no vaginal sac below for the retention of decomposed urine and menstrual discharge.

Fritsch has closed a fistula by denuding the anterior surface of the posterior lip of the cervix in a case of defect of the anterior lip and implanting the posterior lip in the vesical opening.

[1] In a case of vesicovaginal fistula, acquired atresia of the vagina, a retroflexed and fixed uterus with salpingo-oöphoritis, menorrhagia and severe dysmenorrhea, due to the passage of clots from the urethra, the author has been obliged to perform hysterectomy.

The woman menstruated into the bladder, but nevertheless remained comfortable for years.

To close the vagina (colpocleisis), a circular denudation is made around the whole canal 2 centimeters broad, at a sufficient height to preclude the formation of a sac below the level of the fistula; a row of interrupted sutures across the vagina, inserted from before backward, closes the canal. In difficult cases of extensive fistulæ deep within the vagina, and of fixation of the bladder by cicatricial adhesions, the following procedures have been advocated and adopted:

Incision into the anterior bladder-wall by suprapubic cystotomy in the Trendelenburg posture and closure of the fistula from

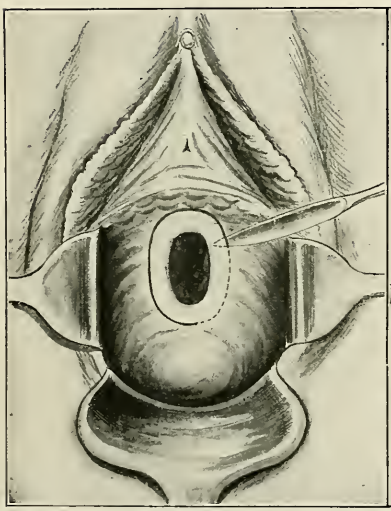


Fig. 717.—Flap-formation as suggested by Ferguson.

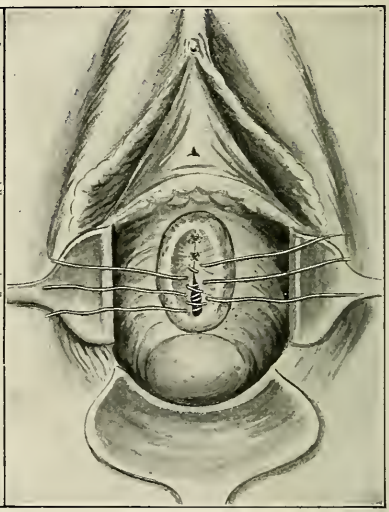


Fig. 718.—Flap turned in and vesical opening closed.

above, silk ligatures, if they are used, being left long and led out of the urethra, whence they are removed by traction after they have cut through the tissue; or buried catgut sutures may be employed (Trendelenburg).

A transverse incision over the pubis, freeing the bladder, and closure of the fistula from the vagina (Fritsch).

Separation of the vagina from the bladder around the fistula, closure of the opening in the bladder, and a separate closure of the vaginal wound, as in anterior colporrhaphy (Winternitz, Mackenrodt).

Opening Douglas's pouch, retroverting the uterus into the

vagina, using its posterior surface (which becomes anterior in the complete retroversion) as a plug to fill in a large defect in the vesicovaginal septum, and making an artificial os in the fundus to allow the escape of menstrual discharge (Freund).

If the urethra is absent or partly destroyed, its restoration is always doubtful. The most hopeful plan is to prepare a flap of mucous membrane as thick as possible from one side, to turn it inward so as to bring the mucous surface within the newly made canal, and to fasten it in a denuded area on the opposite side. The new urethra should be established before the vesical fistula is closed.

Fortunately, continence may be established without the presence of a urethra by leaving a narrow orifice at the neck of the

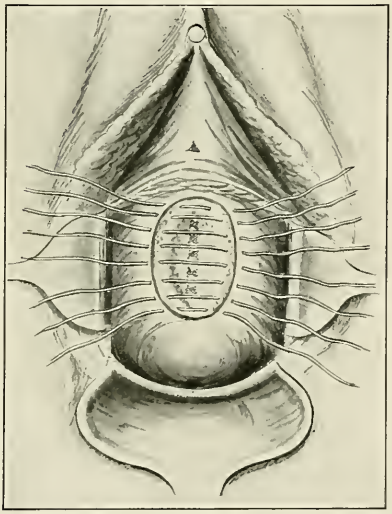


Fig. 719.—The vesical opening closed and sutures inserted to unite the vaginal walls.

bladder. This was accomplished in one of the author's cases after several futile attempts to construct a new urethra, which was entirely lacking, directly back of the external meatus.

If there is such a serious defect of urethra and base of bladder that no plastic operation succeeds in restoring even partial continence, colpocleisis and a rectovaginal fistula may make the patient's condition endurable. But if there is a cystitis at the time of operation, the result may be fatal from an exacerbation of the inflammation and infection of the ureters and kidneys. Indeed, there is always danger after such an operation of pyelo-

nephritis, though occasionally, as in one of Fritsch's cases, the patient remained comfortable and well for years.

The rectovaginal fistula, admitting a forefinger, should be made by a transverse incision just above the sphincter ani, the vaginal and rectal mucous membranes being united by interrupted sutures of catgut. The vaginal orifice is then closed. A double rubber drainage-tube is inserted through the fistula, and during the patient's convalescence the vesicovaginal pouch is frequently irrigated with a boracic acid solution.

The most important question to decide in the *after-treatment* of a vesicovaginal fistula operation is whether to resort to drainage of the bladder or to catheterization. After trying both plans, I prefer the mushroom retention catheter for four days. After the operation the bladder is injected with water to test its impermeability. The vagina is lightly packed with iodoform gauze. The stitches of fine Pagenstecher thread are removed in a week.

If a ureter has been included in one of the stitches, there are the symptoms of deficient urinary secretion, rapid pulse, pain in the back, a tendency to somnolence, and sometimes, though rarely, high fever. There are two courses open to the operator: one is to remove the stitches and to do the operation over again; the other is to trust to nature to overcome the difficulty, which is often done by the stitch cutting through, by the urine under pressure forcing its way through the loop of the ligature, or by the establishment of a ureterovaginal fistula. Occasionally the kidney on the affected side atrophies and the remaining kidney performs the work of two, as after a nephrectomy.

If there is a persistence of incontinence after the operation, the flow of urine may come from a suture track, from a failure of union at some part of the wound, or from a second fistula not detected at the time of the operation. The last two conditions require subsequent operations. A small suture-track fistula often closes spontaneously, and some time should be allowed for this result before subjecting the patient to a second operation, which might be unnecessary.

Intravesical hemorrhage will not occur after an operation for vesicovaginal fistula if the sutures are properly placed. If it does, it is an awkward complication. The bladder should be washed out with boracic acid solution every two hours to prevent the formation of a large clot. If a clot does form in the bladder, causing tenesmus, the injection of pepsin solution has been recommended to soften it.

The Treatment of Ureteral Fistulæ and of Surgical Injuries of the Ureters.—There are three kinds of surgical treatment for ureteral fistulæ: nephrectomy, a plastic operation in the vagina (*colpo-*

uretero-cystostomy or *ureteral anastomosis*) and an abdominal section, followed by the junction of the ureter (*celio-uretero-ureterostomy*) or its implantation in the bladder (*celio-uretero-cystostomy*).

A *nephrectomy* is often the easiest way to remove the disagreeable symptoms of a ureteral fistula, but it is not the ideal operation. There must always be some doubt as to the adequacy of the remaining kidney, and the natural impulse is to avoid the removal of such an important organ unless it is itself diseased. It must be admitted, however, that the operation has been repeatedly performed with success. Several of the women[1] have subsequently been delivered at term without the slightest disturbance of health. As in nephrectomies for any indication, the most scrupulously careful examination should be made of the secretion from the remaining kidney by catheterizing the ureter or by vesical segregators (Harris's, Cathelin's, or Luys's). If the kidney corresponding to the ureteral fistula shows evidence of pyelonephritis or hydronephrosis, there is additional justification for its removal, but it should be remembered that both of these conditions have disappeared after closure of the fistula by vaginal or abdominal operations.

Nephrectomy should, in general, be limited to those cases in which the closure of the fistula has proved impracticable by both the vaginal and abdominal routes or in which there is marked hydronephrosis or pyelitis.

The operation may be performed by a lumbar incision or by the transperitoneal method. The latter is often easier for the surgeon, but may not be so safe for the patient. There is no necessity for the exsection of the ureter, and there need be no fear of the regurgitation of urine from its lower segment. If the transperitoneal operation is selected, the incision should be made laterally through the abdominal wall directly over the kidney. The posterior parietal layer of the peritoneum is opened, the kidney delivered, and its pedicle (blood-vessels and ureter) is tied with silk or catgut by passing a pedicle needle through its middle, tying in both directions, and then back again around the whole stump. This step in the operation is usually easier in the transperitoneal than in the lumbar operation. Both layers of peritoneum are closed.

In the lumbar operation the kidney is delivered and the vessels, with the ureter, ligated.

The lumbar incision should always be preferred if there is pyelonephritis or perinephritis, or if the most perfect aseptic technic is impracticable. Many operators accustomed to nephrorrhaphy by this method prefer it uniformly.

[1] Fritsch reports three cases (*loc cit.*).

The Vaginal Operations for Ureteral Fistula.—The first requisite for a successful plastic operation by the vagina is to find the upper end of the ureter and its orifice, which is not always easy to do. If there is not too much scar-tissue the ureter may be dissected out, implanted into an incision made into the bladder, and fastened in place by several interrupted sutures of fine catgut. The vaginal wound is closed over the end of the ureter and the opening in the bladder into which it has been implanted (Parvin, McArthur). It has sometimes been possible to sew the mucous membrane of the bladder to the mucous membrane of the ureter and so to fasten the latter in place. The vaginal mucous membrane, dissected back on each side by a flap-splitting dissection, is united over the ureter and the newly made opening into the bladder.

Schede's operation has given, on the whole, the best results: a vesicovaginal fistula is made close by the ureteral fistula, the mucous membrane of the bladder and that of the vagina being united by interrupted sutures of catgut; an oval denudation is made 1 centimeter wide around both the ureteral and the vesical fistula, leaving a strip of undenuded membrane 0.5 centimeter wide immediately surrounding both fistulæ. The denuded surfaces are united by interrupted sutures, thus directing the stream of urine from the ureter into the bladder.

Bandl's operation is only practicable if both ends of the ureter are discoverable and are normally patent. A ureteral catheter is passed into both the lower and the upper segments of the ureter, emerging from the urethra. A denudation is made and united as in Schede's operation, but without making a vesicovaginal fistula. If the catheter is fenestrated the whole bladder is drained by it, or the urethra may be drained by a rubber tube through which the ureteral catheter passes.

Mackenrodt's operation is very ingenious and has been successful in the few cases in which it was tried. A vesicovaginal fistula is made near the ureteral fistula. A semicircular thick flap of vaginal mucosa is dissected off, so that it carries the ureteral opening in its center, has its attached base next to the vesicovaginal fistula, and its free edge away from it. By turning this flap over a half circle on its base it closes the vesicovaginal fistula like a lid; it is sewed in place by catgut sutures, with the vaginal mucous membrane directed into the bladder, and so turning the ureteral fistula into the bladder. The raw surfaces left by the removal of the flap and over the vesicovaginal fistula are united with interrupted sutures or are allowed to granulate.

Dudley's operation, as Reynolds[1] says, is a crude procedure,

[1] "Boston Med. and Surg. Jour.," 1901, p. 84.

but has succeeded when other plans have failed. A sharp-pointed artery or other similar forceps is passed into the urethra; a vesicovaginal opening is made; one blade of the forceps, which is opened for the purpose, is pushed out of the incision in the bladder; the renal end of the ureter is threaded on it; the handles of the instrument are closed and tied, thus clamping the end of the ureter to the bladder wall. The forceps is lightly pulled upon after eight or ten days. If it does not come away it is opened and extracted.

The Abdominal Operation for Ureteral Fistula or Injury.—If the ureter is injured during an operation, it may be repaired in several ways: If the incision is linear or fails to sever the ureter completely, the wound may be repaired by fine catgut sutures, mattress or interrupted, with considerable certainty of success. If the ureter is completely severed, is fenestrated or badly crushed, as by clamp forceps, it may be rejoined by an end-to-end anastomosis (Tauffer, Bovee), by an end-to-end (Pozzi) or a lateral invagination (Van Hook's uretero-ureterostomy), or by a lateral anastomosis. In the first, a section of a ureteral catheter is passed into both segments of the ureter, with a silk ligature tied around its middle to recover it by if it should slip down the lower portion of the canal. Interrupted sutures of fine silk or formalin catgut are passed through walls of the two ends of the ureter; before the knots are tied the catheter is withdrawn. The author has had one successful end-to-end anastomosis.

Van Hook's lateral invagination is the most reliable operation. The upper end of the lower segment of the ureter is ligated; a linear incision is made through its wall below the ligature twice as long as the diameter of the ureter; the upper segment is implanted into this incision and is fastened by fine sutures at both ends of the wound; the edges of the incision are then carefully sewed to the ureteral wall passing between them, so that the opening is securely closed. If a junction of the two ends of a severed ureter is impossible, as in a case of old injury, extensive destruction of tissue or the removal of a considerable portion of the ureter in the wall of a cyst or a fibroid tumor, *implantation of the upper segment into the bladder* (celio-uretero-cystostomy) is indicated. This may be done by a transperitoneal or an extraperitoneal operation. In the former the peritoneum over the ureter is incised, usually in the neighborhood of the bifurcation of the iliac arteries; the ureter is dissected free, care being taken not to isolate it too extensively, on account of danger to its nutrition. An incision is made into any portion of the bladder-wall which the ureter reaches without tension; the end of the ureter is inserted into the opening so that it projects somewhat into the bladder; the edges of the wound in the

latter are carefully sewed to the wall of the ureter by interrupted or mattress sutures, and its angles are closed by separate sutures. Penrose recommends splitting the end of the ureter, putting a mattress suture in each lip, and passing each end of the mattress sutures, rethreaded on a fine needle, through the bladder-wall, tying them on the peritoneal surface of the bladder. This plan avoids occlusion of the ureteral orifice and prevents the ureter slipping out of the bladder.

There are disadvantages in the transperitoneal operation. Failure may mean fatal peritonitis in spite of drainage; and the band of isolated ureter traversing the pelvic and lower abdominal cavities may cause intestinal complications.

The extraperitoneal operation is the ideal one if it is practicable. The implantation of the ureter in the bladder by a vaginal operation has been described (p. 890). In an abdominal operation it may be possible to reach the upper segment by incising the anterior layer of the broad ligament and the vesicouterine pouch, and to implant the ureter under the peritoneal covering of the latter.

Witzel proposes to free the ureter as in the transperitoneal operation, carrying its end by forceps around the brim of the pelvis under the peritoneum, and bringing it forward above the anterior parietal peritoneum. Both incisions in the peritoneum are closed and the operation is concluded extraperitoneally by implantation of the ureter in the bladder, the ureter being cut obliquely, so that its end is a point, the bladder being incised obliquely, so that the implanted ureter runs some distance in its wall. It is necessary to fasten the bladder wall to the pelvic connective tissue by catgut sutures to avoid tension on the implanted ureter. Mackenrodt modifies this procedure by making his abdominal incision at the outer edge of a rectus muscle; separating the peritoneum to the bifurcation of the iliac artery, bringing the end of the ureter forward above the peritoneum, puncturing the bladder from within by a trocar, and drawing the end of the ureter into it. If the ureter is so much shortened that its upper portion cannot be made to reach the bladder without too much tension, the following ingenious plans have been proposed to splice it: The two ends of the ureter are brought out on the abdominal skin and fastened there; after the wound has healed, a tube of skin is made between the two ureteral orifices by parallel incisions, and uniting the free edges of the skin; the tube is depressed and covered over by uniting the outer edges of the parallel incisions (Rydygier). A diverticulum is constructed from the anterior bladder wall, into which the upper end of the ureter is implanted (Van Hook, Boari, Casati). The ureter is spliced

by a hollow, decalcified turkey's-wing bone sewed in the ureter and the bladder (Van Hook). The ureter is spliced by a segment of small intestine, separated from the bowel which is joined, by an end-to-end anastomosis; the segment of gut is left attached to its mesentery and is closed by sutures at both ends. The two ends of the ureter are implanted in the segment of bowel (Bacon). The appendix is used to splice the ureter (Giannettasio). The ureter is implanted in the Fallopian tube (D'Urso and Fabii). These propositions have been theoretical or else the result of experiments on dogs.[1]

As in all intra-abdominal operations on the ureters and bladder, the Trendelenburg posture is essential, and gauze drainage afterward is necessary in case the closure of the bladder or junction of the ureters proves imperfect.

Bovee[2] collected 111 uretero-cystostomies to 1903.

Operations for Acquired Stenosis or Atresia of the Vagina.—The **treatment of stenosis of the vagina** has for its object the dilatation of the canal. This is accomplished in various ways. Gradual dilatation with bougies may suffice; but the treatment must be continued persistently a long time and may not lead to a permanent cure. Fibromyxomatous bands and membranes stretched across the vagina should be excised. Usually there is no occasion for hemostasis, but it is advisable to draw the mucous membrane over the wounded surfaces by interrupted sutures of catgut. Cicatricial bands under the mucous membrane should be incised as deeply as possible wherever they are felt to be most tense. They may be torn by the finger even more deeply than they can safely be cut. The mucous membrane alone is united over the wounds with interrupted sutures introduced in a direction parallel with the cut, so as to further enlarge and not to contract the vagina. A vaginal plug (Sims') of glass, hard rubber, or metal should then be inserted, and should be retained continuously for a month, being removed daily to be cleansed and to allow irrigation of the vagina. The plug should be worn for a few hours daily during the year succeeding the operation, being retained by a napkin or by special apparatus which the author has employed with satisfaction (Fig. 720).

If the stenosis exceeds the whole length of the vagina and is extreme in degree, the success of any treatment is problematical. If the patient comes under the physician's observation when she is pregnant, a Porro Cesarean section is required at term. After

[1] Henry Morris, "Surgical Diseases of the Kidney and Ureter," vol. ii, p. 608, and Nicholson, "Treatment of Severed Ureters," "Amer. Jour. Med. Sci.," April, 1902.

[2] "Am. Gyn.," July, 1903.

the removal of the uterus the stenosis of the vagina requires no treatment.

The **treatment of atresia** has for its object the restoration of the caliber of the vagina and the restitution of an external outlet for the discharge of the genital tract. The same principles obtain in the treatment of congenital and acquired atresia, but the latter is often more difficult to deal with. The condition of the tubes should receive the first attention. If there is hematosalpinx, the tubal sac should be removed by an abdominal section before the vagina is opened and the blood in the uterus and vagina is evacuated. The numerous deaths after operations for atresia have

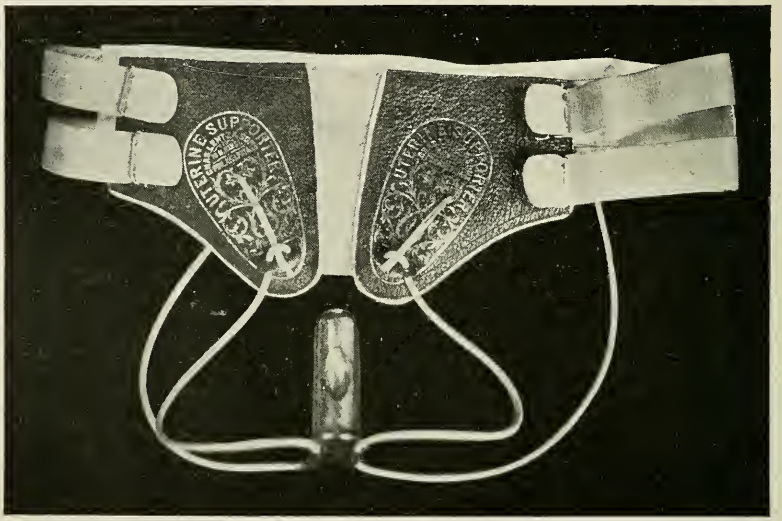


Fig. 720.—Silver plug (Sims') supported by abdominal belt and rubber bands.

been due to tubal infection or rupture and a consequent peritonitis.

To open the occluded vaginal canal it may be sufficient to make a crucial incision in a membranous septum or to excise it at its base. The retained blood, as thick sometimes as tar, flows out slowly and should be thoroughly washed away by a boracic acid solution. The wounded surface encircling the vagina, if the membrane is excised, is covered with mucous membrane by inserting interrupted sutures from above downward, uniting the mucous membranes of the healthy portions of the vagina. If the atresia involves a considerable length of the vagina, a blunt dissection is required between the bladder and rectum, with a sound in one and the forefinger of the left hand or a bougie

in the other, the tissues being separated by the blunt end of a closed scissors, the occasional stroke of a knife, and the operator's fingers. When the accumulated fluid is reached and evacuated, the opening which has been secured by a blunt dissection should be enlarged as much as possible by graduated bougies, the fingers, or powerful branched dilators, the force being applied laterally so as to avoid injury to the bladder or rectum. The problem is how to prevent a reclosure of the canal. This has been accomplished in several ways: The prolonged retention of a plug with the idea that the caliber of the vagina shall be maintained while a proliferation and extension of the vulvar epithelium finally covers the raw surfaces with a new mucous membrane; the implantation of flaps gained by cutting loose the labia minora except at their bases, splitting them longitudinally, joining them together, suturing their edges, and inverting them into the vagina, where they are sewed fast (Küstner); implanting a tube of vaginal mucous membrane obtained from a prolapsed vagina in another patient, as has been successfully done by Mackenrodt and by the author;[1] implanting intestinal mucous membrane secured by resection of the bowel in another patient ([illegible]): making a flap anteriorl[illegible] cluding the vagina and a [illegible] flap of the skin on the labium majus, [illegible] between the bladder and rectum forming a cavity [illegible] flaps are sutured (Fleming). In all of these methods some plan must be adopted to keep the vagina distended and the transplanted flaps or implanted membrane in close apposition with the

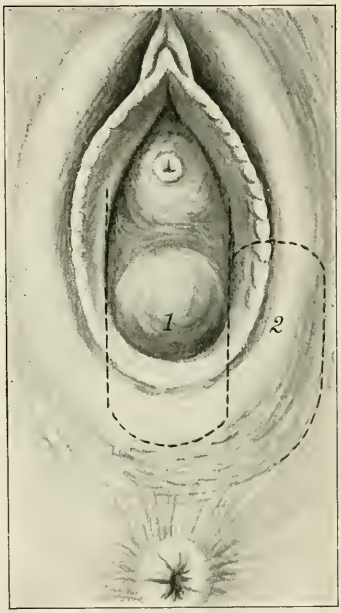


Fig. 721.—Fleming's operation for making an artificial vagina: 1, Anterior flap; 2, posterior flap. These flaps are turned into the canal made by a blunt dissection and are sutured [illegible]

[1] In the author's case a woman with total prolapse was operated upon first; two broad strips of mucous membrane were excised, sewed together with catgut around a cylindrical speculum, and placed in a warm normal salt solution. A rapid blunt dissection was then performed on the patient with atresia to a depth of 3 inches. The vaginal mucous membrane on the speculum was implanted, the latter withdrawn after being filled with iodoform gauze, which remained in the vagina undisturbed for two weeks.

raw surfaces. A tampon left undisturbed for a number of days and a vaginal plug have been employed for this purpose, but there are objections to both plans. Noble's suggestion to insert a pouch of thin rubber tissue and to distend it with gauze packing is a good one. When the newly made vagina is clothed with mucous membrane by any one of the methods just described, systematic attempts to retain a sufficient caliber in the canal should be begun about three weeks after the operation, either by regular daily dilatation with a bougie or by the use of the vaginal plug, worn daily for at least an hour. Occasionally the most satisfactory operation for atresia is hysterectomy. In a case under the author's care a

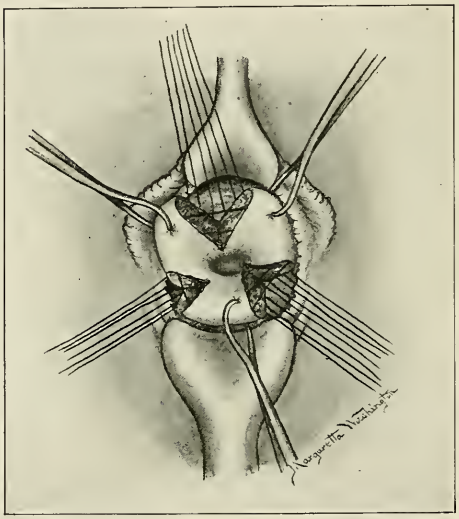


Fig. 722.—Repair of a stellate tear of the cervix.

Le Fort operation on the vagina had been performed by another operator three years before; on examination a row of silver sutures was found extending across the vagina, where they had been for three years. There was complete atresia, with extremely firm cicatricial contraction, a pyelythrometra, which had ruptured into the bladder, an extensive vesicovaginal fistula above the site of atresia, double pyosalpinx, and a general septic intoxication. The patient was cured by a hysterectomy and the removal of the uterine appendages. With no further discharge into the upper vagina the vesicovaginal fistula closed spontaneously. The atresia was not corrected, as the only purpose of such treatment would have been to establish a coitional vagina, which is not always practicable in the absence of the uterus. Even were permanent suc-

cess assured, the propriety of medical treatment to that end is questionable.

Sneguireff[1] has thrice successfully performed a curious operation for making a coitional vagina: An incision is made alongside the sacrum and coccyx; the latter is excised; the rectum is freed for 3 inches above the anus and is cut across at the level of the third sphincter; the end of the upper segment is implanted below the tip of the sacrum; the upper end of the lower segment is closed by sutures; a knife divides the whole length of the septum between the lower segment of rectum and the blind pouch representing the vagina; the mucous membranes of the two pouches are sewed together. It is claimed that continence of gas and feces is finally established. Isaacs[2] has made a coitional vagina by a circular incision around the site of the introitus; pushing the skin thus detached in to a depth of 3½ inches and applying Thiersch's grafts between the sides of the glass vaginal plug and the raw surface of the artificial canal.

Fig. 723.—1, Denudation for repair of lacerated cervix; 2, sutures inserted; 3, sutures united.

Operations on the cervix for the injuries of parturition are two in number: trachelorrhaphy and amputation. Trachelorrhaphy is required for bilateral laceration and may also be utilized

[1] "Zwei neue Fälle von Restitutio vaginæ per transplantationem ani et recti," "Zentralbl. f. Gyn.," No. 24, 1904.

[2] "N. Y. Med. Record," Nov. 19, 1904.

for the cure of stellate lacerations. Repair of a lacerated cervix cannot be undertaken until after the fifth day of the puerperium on account of the danger of infecting the endometrium. The best time is at the end of the first week, when the danger of infection, with a satisfactory technic, is over. It is the necessity of postponing the cervical operation which imposes delay upon the operator in repairing the other injuries of childbirth. Moreover, better results can be obtained, both in diagnosis and treatment of all the injuries of the birth-canal, if the bruising, edema, and distortion of the tissues present immediately after labor has

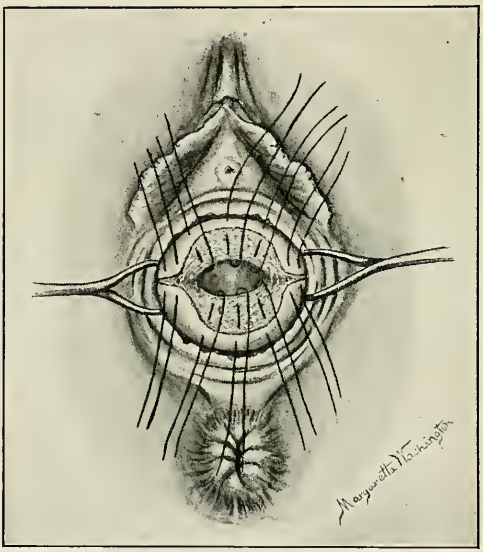


Fig. 724.—Hegar's amputation : Stitches introduced.

disappeared. The argument against intermediate operations that the flow of lochia over unclosed wounded surfaces predisposes to sepsis is fallacious. The author's experience during the last six years, in which the intermediate as against immediate operations have been uniformly preferred, justifies this statement.

For trachelorrhaphy the two lips of the cervix are seized with double tenacula and pulled down, an Auvard's speculum retracting the posterior vaginal wall. Denudation is resorted to if necessary. The raw surfaces are united with interrupted sutures of chromic gut. Care must always be exercised to leave a wide cervical canal (Fig. 723). For amputation of the cervix, which is required when the injury or sloughing leaves a condition irreparable by plastic surgery, a circular incision is made above the site of the

injuries and the cervix is amputated in healthy tissue. The sutures of chromic gut are inserted according to the modified Hegar plan as illustrated in Fig. 724.

Vaginal section is required for vaginal hysterotomy, for vaginal Cesarean section, for pelvic abscess, for hematocele; possibly for ectopic pregnancy and for inflammation of the appendages. The vaginal vault may be opened posteriorly or anteriorly: in the former case by a transverse incision through the vaginal wall of the posterior vault, the cervix being pulled down with a tenaculum; the peritoneum is opened with sharp-pointed scissors. In the latter case the cervix is pulled down, a T-shaped incision is made, the vaginal flaps are dissected back, the uterovesical ligament is cut, and the peritoneum is opened with scissors.

Myomectomy by the vaginal route, possibly required for the removal of such a tumor as is represented in Fig. 558, is best performed by an anterior vaginal section; an anterior median hysterotomy, extending through the cervix and high enough to give access to the base of the tumor, the cervix being steadied and pulled down by tenacula. The uterine wound is united by a double-tier stitch of chromic gut, the vaginal wall is closed with interrupted sutures, and the vesico-uterine pouch is drained by a gauze strip. The vagina is packed.

PREPARATION FOR ABDOMINAL OPERATIONS.

For private house operations—emergency ectopic pregnancy operations, Cesarean sections, etc.—the operator takes with him a portable sterilizer containing the following articles: 12 towels; 20 pieces of folded gauze; 1 large pad of absorbent cotton; 4 sheets; 3 long-sleeve gowns; 1-inch bandage; 6-inch bandage; 1 glass tube of plain packing; 6 brushes; 2 rubber sheets; package of gauze pads; tubes of celloidin thread and catgut; the necessary instruments, and a portable operating table. A list is furnished of things to have in readiness in the house (p. 864).

The preparation of the patient's skin has been described. The abdominal dressing is turned down on the woman's thighs; the abdomen is covered with a piece of sterile rubber dam, 18 inches square. A sterile sheet is folded over the patient's thighs and legs; another one over her chest. Four towels surround the field of operation, secured by clips, as illustrated in Fig. 725. A cut with scissors is made through the rubber dam; the skin is incised; then the fat and fascia with a knife; the rectus muscle is split with the fingers; the rubber dam is sewed in the wound with a stitch on either side, so that its edges are folded into the wound (Fig. 726); the peritoneum is caught by two hemostats and incised between them.

The abdominal wound is closed by a running stitch of No. 1 chromic gut in the peritoneum; two interrupted sutures and a

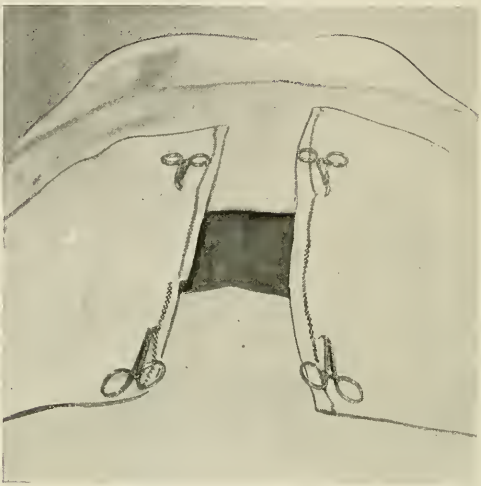


Fig. 725.—A sheet of rubber dam over the abdomen, surrounded by towels.

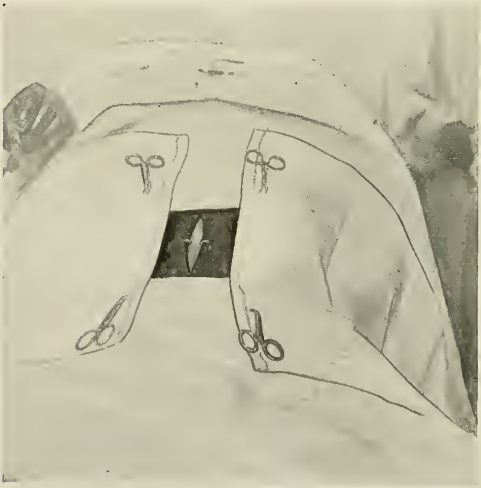


Fig. 726.—The rubber dam split with scissors and the abdomen incised to the peritoneum. The edges of the rubber dam are sewed in the wound with two sutures, so that they cover the skin and fold into the wound.

running suture of the same sized gut in the fascia; a double-tier suture of No. 0 gut in the fat and a subcuticular stitch of silkworm gut, which gives a permanently narrow scar. The stitch is removed

on the tenth or twelfth day. The wound is sealed with inch wide strips of gauze and collodion. A pad of gauze and adhesive straps are put over the collodion dressing, which is dusted with sterile talcum powder to prevent its sticking to the upper dressing. The pads and straps are removed in forty-eight hours, leaving nothing on the abdomen but the narrow strip of gauze and collodion dressing, which is removed in ten to twelve days. The patient is allowed considerable liberty of movement in bed. She is given cool water to quench her thirst as soon as she asks for it; the feeding is albumen-water, broths, barley-water, and tea, begun in twenty-four hours. At the end of forty-eight hours she gets a course of calomel in divided doses; on the third day a saline laxative in 2-ounce

Fig. 727.—Abdominal wound sealed with collodion and gauze. The only dressing on the abdomen after forty-eight hours.

doses, two hours apart, till 6 to 8 ounces are taken. (I prefer Sprudel water and Carlsbad salts or citrate of magnesia.)

Drainage is provided by gauze, by tubes, by the horsehair capillary drain, and by gravity through an opening in the dependent portion of the area to be drained. The gauze drain is used in the following forms: In the shape of a pack, filling a cavity flush with the exterior; as a pack, communicating with the exterior by a strip; as a wick rolled on itself; as a wick protected in a part of its length by rubber covering; as a wick with alternate layers of gauze and rubber—the cigarette drain. The tube is curved or straight and of glass or rubber. To prevent its slipping out of a cavity in which it drains the most dependent portion, as in Douglas' pouch through the posterior vaginal vault, it must have a T shape. The most suitable form of drainage for a given case must be chosen by the operator

at the time of operation, his choice being guided by good judgment and experience. The most thorough drainage is secured by the combination of the curved glass tube and the gauze pack, the former being placed in Douglas' pouch, and the latter filling the pelvis and emerging alongside the tube at the lower angle of the abdominal wound.

Drainage is almost invariably required in streptococcic suppuration; in other conditions in the peritoneal cavity it should be avoided if possible.

Hysterectomy or removal of the uterus is required for suppurative metritis or perimetritis, for streptococcic necrosis, neoplasms of the uterus, rupture of the walls, in the Porro Cesarean section,

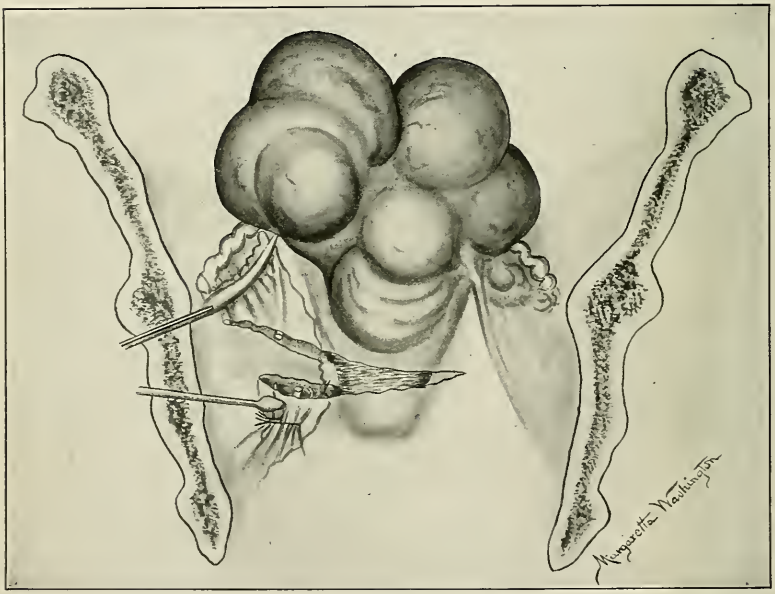


Fig. 728.—Ligation of the ovarian artery and the artery of the round ligament; division of the broad ligament between clamps.

in exceptional cases of inversion, and in irreducible incarceration of a displaced uterus. It is an operation of election if the appendages are removed.

The hysterectomy may be partial or total; it may be performed by the abdominal and by the vaginal route or by both combined.

Partial hysterectomy includes exsection of wedge-shaped pieces of the wall (cuneiform hysterectomy), and amputation of the uterus at the level of the internal os. The first consists in excising with a knife a portion of the uterine wall, as at the fundus or

the cornua for streptococcic necrosis, uniting the myometrium with a two-tier suture of chromic gut, and closing the perimetrium with a lace suture of chromic gut, as in a Cesarean section (Fig. 680). The second consists of the following steps: Ligation of the ovarian arteries; ligation of the arteries of the round ligament; fastening a hemostat above the ligatures on the broad ligament; clamping the whole breadth of the broad ligament above the hemostats; cutting through the broad ligament in an oblique direction downward to the level of the internal os; clamping the uterine arteries as they are cut; preparing peritoneal flaps on the anterior and posterior walls of the lower uterine segment; cutting through the cervix and removing the womb; ligating the uterine arteries; sewing together the peritoneal flaps and the edges of the broad ligament. The suture for the last-named purpose can be run from

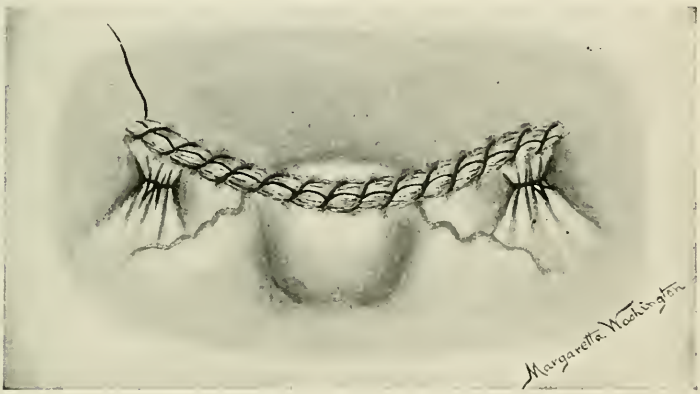


Fig. 729.—Closure of peritoneum over the stump after hysterectomy by supravaginal amputation of the uterus.

side to side; or can be begun in the middle of the cervix, anteriorly, uniting the anterior surfaces of both broad ligaments to one another, the posterior surfaces in the same way, and ending at the middle of the cervix posteriorly. The latter plan, if practicable, has the advantage of bringing the raw surfaces of the stumps of the outer portions of the broad ligament face to face and covering them. Panhysterectomy may be required for septic infection and is necessary for malignant neoplasms. The steps are the same as in amputation of the womb at the cervix, except that after cutting the uterine arteries, the cervix and the upper portion of the vagina are dissected clear of all their attachments; two right-angled clamps are fastened on the vaginal walls; the vagina is cut across between them; several interrupted sutures unite the vaginal walls and the peritoneal edges are closed as before described. In operations for septic

infection a gauze drain leading into the vagina is placed under the peritoneum. Preparatory to this operation the vulva and vagina are carefully cleansed and the latter is packed with sterile gauze.

Vaginal hysterectomy has a narrow field. For some septic and necrotic conditions of the uterus, for some malignant neoplasms with extensive sloughing, for incarcerated prolapse and retroflexion with gangrene, it may be preferred. The vaginal vault is opened anteriorly and posteriorly; the vaginal wall is cut laterally; the broad ligaments are secured by ligatures or clamps, the latter often being much the easier method, and after they are cut the

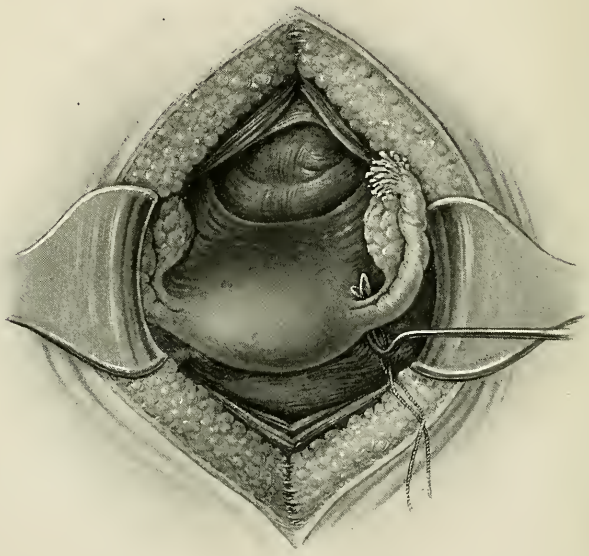


Fig. 730.—Insertion of pedicle needle under ovarian ligament and close to uterus for salpingo-oöphorectomy.

uterus is removed. It usually facilitates the operation to bisect the uterus before securing and severing the broad ligaments.

Combined hysterectomy has also a limited application. Either the abdomen is first opened, the broad ligaments ligated and cut, as already described, and the vaginal attachments of the uterus severed from below; or, the vaginal part of the operation is first performed and the hysterectomy completed from above.

Salpingo-oöphorectomy, indicated for infectious inflammations, neoplasms, ectopic pregnancy, and to establish the menopause, as in cases of ill-developed uterus (p. 66), may be performed in the following routine manner: The tube is cut off from the uterus

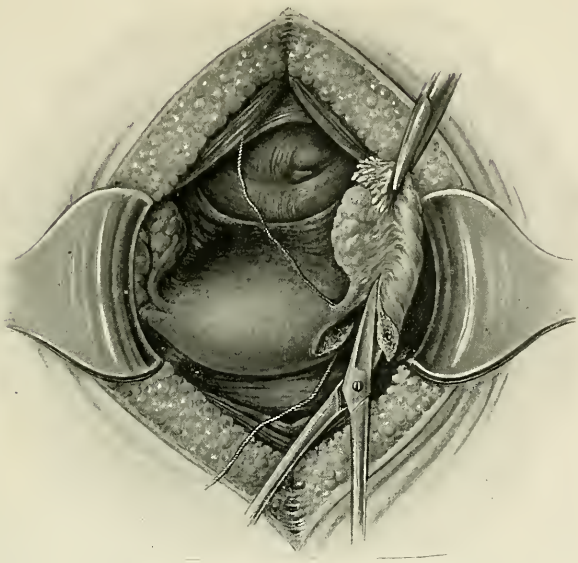


Fig. 731.—Cutting tube from cornu, so as to have no tubal stump.

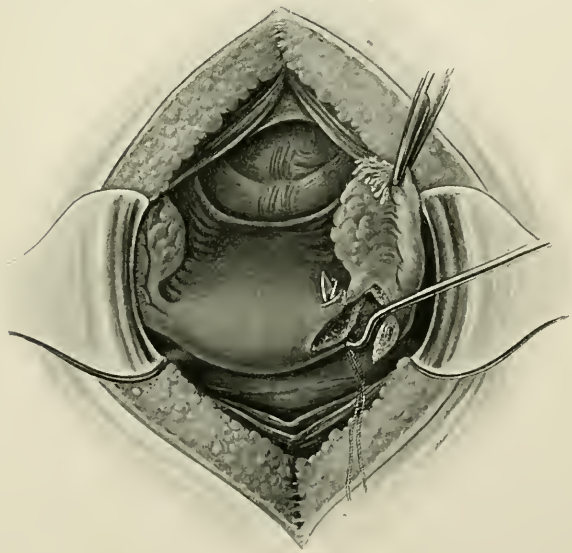


Fig. 732.—Insertion of second ligature, to be tied around the outer edge of the broad ligament.

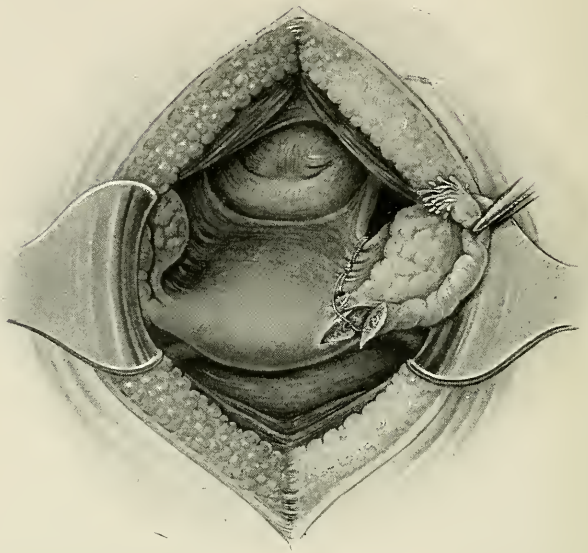


Fig. 733.—The whole breadth of the broad ligament surrounded by the two ligatures.

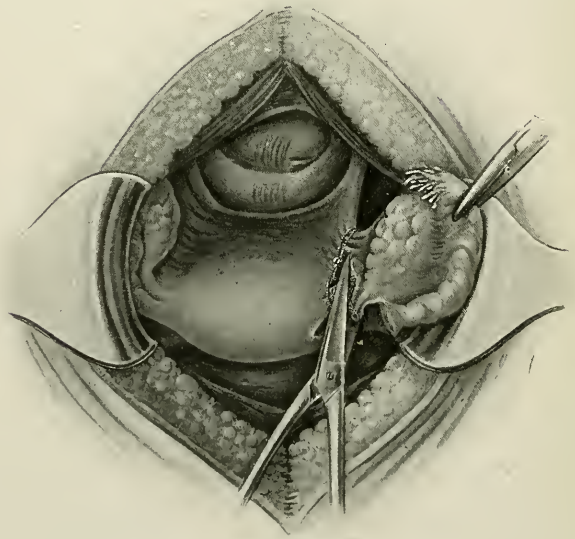


Fig. 734.—Tube and ovary cut away.

at the cornu, leaving no tubal stump; a catgut ligature (size 3, chromic) is carried through the broad ligament by a pedicle needle below the ovarian ligament and inside the round ligament; it is tied over the broad ligament between the uterus and the cut uterine end of the tube. Another ligature is inserted below and inside the first; it is tied over the outer edge of the broad ligament below the ovary. A hemostat is fastened over the broad ligament above each knot. The tube and ovary are removed by severing the puckered broad ligament above the hemostats. The raw

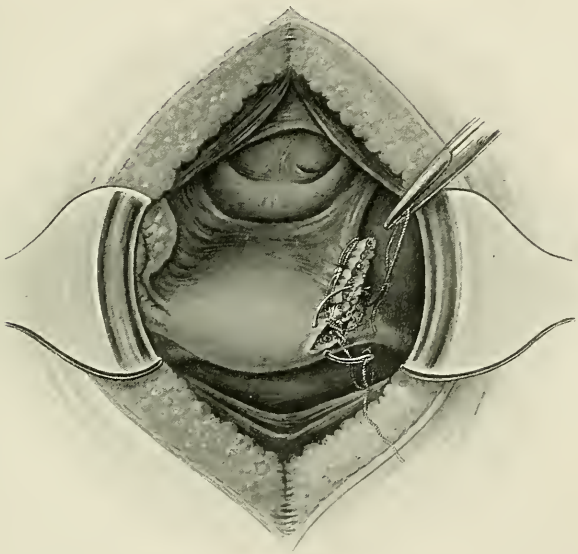


Fig. 735.—Cornual wound closed.

surface at the uterine cornu is united with a double-tier suture of catgut.

The technic of ligating the broad ligament may be varied in the following ways: if it is desired to remove the tube alone and not the ovary (salpingectomy), the second ligature is tied above the ovary and below the abdominal ostium of the tube. If the broad ligament is too thick to be included in a mass ligature, the vessels are either tied separately where they bleed, or the ovarian, the uterine, and the round ligament arteries are ligated separately, as in Fig. 736. The upper cut edges of the broad ligament should be left gaping if the intraligamentary space is infected, the abdomen being drained; or in non-infected cases the edges of the broad ligament are whipped together.

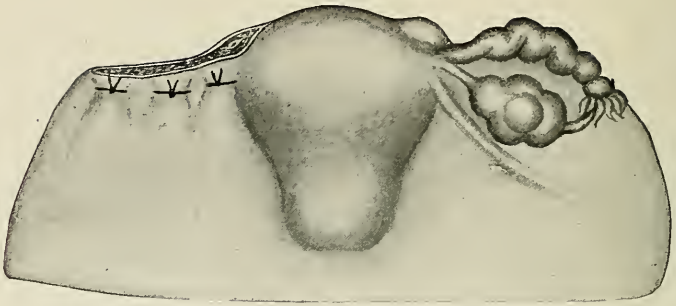


Fig. 736.—Ligatures tied; tube and ovary removed with wedge-shaped exsection of uterine cornu.

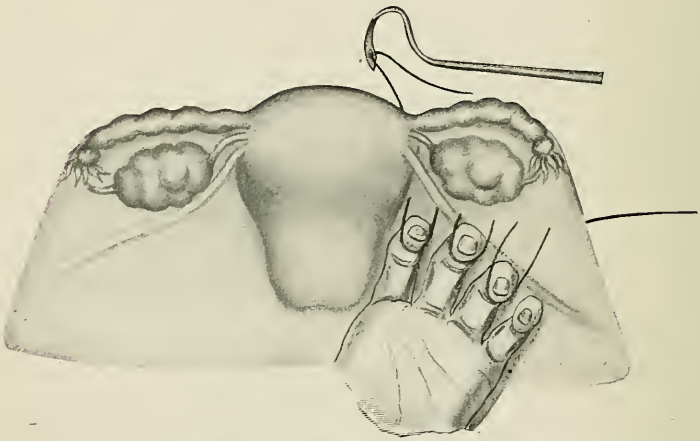


Fig. 737.—Inserting a chain ligature in the broad ligament.

Fig. 738.—The loops of the chain ligature are cut, the ends intertwined and tied.

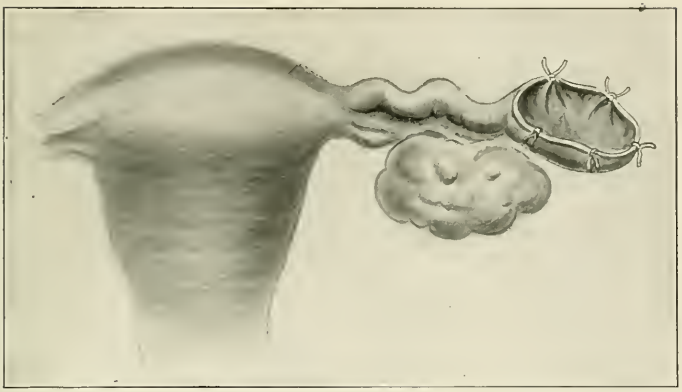


Fig. 739.—Excision of tubal wall for sterility from occlusion of the abdominal orifice.

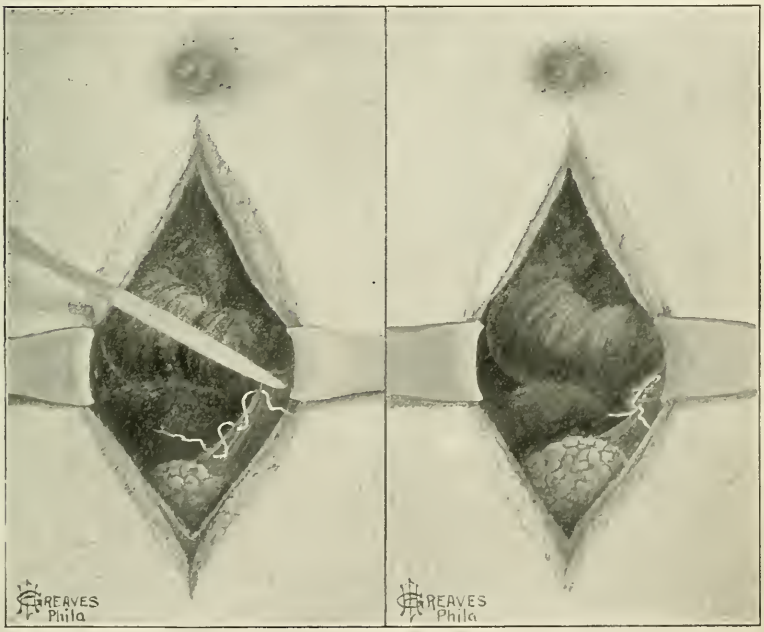


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Fig. 740.—Suspension of the ovary by shortening the infundibulopelvic ligament: 1. Suture inserted; 2, suture tightened. By making three insertions of the needle there is no loophole left between the edges of the broad ligament.

If the broad ligament is so much increased in breadth, as in some ovarian and broad ligament tumors, that the mass ligature is not to be trusted, the chain ligature is required (Fig. 737).

If only a part of the tube, say the outer third, is removed, it is cut away; the vessels are tied separately where they bleed and the mucous membrane of the tube is united to its peritoneal investment by four interrupted catgut stitches (partial salpingectomy).

If the ovary alone is removed, a ligature is carried through the middle of the mesovarium; it is tied in both directions around the mesovarium; the ovary is cut away above the ligature. If a diseased portion only of an ovary is removed, a wedge-shaped exsection is performed, the cuneiform wound being united by close set interrupted sutures of catgut.

Suspension of the ovary is indicated for prolapse due to lengthening of the infundibulopelvic ligament if the patient complains of symptoms severe enough to demand relief—namely, pelvic pain, nausea, and dyspareunia. The operation consists in inserting a needle and celloidin thread first, close to the ovary and just under the ligament, next about $\frac{1}{2}$ inch, and then, finally, about an inch or more away from the ovary. By tying the ends of the thread the ligament is shortened by the distance between the first and third insertion of the needle.

If the operation on the tube is to restore its patency on account of closure of the abdominal ostium, either partial salpingectomy or salpingostomy is required (Fig. 739). The latter operation consists in buttonholing the tube on its upper aspect near the abdominal extremity and uniting its mucous lining to its peritoneal investment by a few interrupted sutures.

Exsection of Abdominal and Pelvic Tumors by Abdominal Section.—The removal of ovarian cysts; the enucleation of parovarian cysts; myomectomy for fibromyomata of the uterus and of the broad ligament are not infrequently indicated in the childbearing woman.

Oöphorectomy for pseudomucin, serous cystadenomatous, simple retention and serous, lutein, and dermoid cysts, teratomata, fibromata, and the malignant tumors is accomplished by transfixion and ligation of the mesovarium or of the broad ligament, as already described in the technic of salpingo-oöphorectomy. The chain ligature is required for a broad pedicle. If the operation is performed after delivery when the involution of the uterus is far advanced or accomplished, the uterus should be suspended to prevent the adherent retroversion which is a common sequel of the removal of ovarian tumors. If the cyst is twisted on its pedicle, the pedicle should be untwisted and the ligatures placed in the broad ligaments beyond the thrombus, which is usually seen in the ovarian vein. The cyst should not be punctured if its contents might contaminate the peritoneum or cause implantation metastases. If the operation is undertaken in pregnancy the following rules should

be observed: In early pregnancy not to disturb the pregnant uterus; in operations near term to perform a coincident Cesarean section and to remember the unusually large proportion of dermoids found among ovarian cysts in pregnant women (one-quarter), and therefore not to puncture the cyst if there is any doubt about its contents.

The enucleation of broad ligament tumors is accomplished by incising the anterior face of the broad ligament, shelling out the tumor from its bed, removing redundant portions of the broad ligament capsule, obliterating as far as possible the raw bed of the tumor by tier sutures or draining the cavity by vaginal puncture, packing the cavity with gauze, and uniting the peritoneum above it. Myomectomy for uterine fibromata requires ligation of the pedicle if it is small enough (no larger than one's thumb), exsecting it by a wedge-shaped incision if it is too large to ligate, or splitting its capsule and shelling it out, the bed of the tumor being completely obliterated by tier sutures. If myomectomy is required near term or during labor, a Cesarean section should be part of the operation. The operator must remember that it is usually safer to remove the uterus after it is evacuated, but in a case peculiarly suitable for myomectomy alone, it is perfectly possible to leave the uterus intact.

Inguinal section is required for the removal of fibromyomata of the round ligament and for shortening the round ligaments. For the first purpose an incision the length of the tumor is made parallel with Poupart's ligament through the skin, fat, and transversalis fascia. The tumor is shelled out if possible without opening the peritoneal cavity. The base of the tumor, however, may be adherent to the peritoneum, in which case a wide opening into the peritoneal cavity is required. The wound is closed so that the inguinal canal is obliterated, as in the Bassini operation; the oblique muscle is joined to the peritoneum at the base of the canal and to Poupart's ligament by a tier stitch; the fascia is united by a running stitch; the fat and superficial fascia by a double-tier stitch of No. o unchromicized gut; the skin by a subcuticular stitch.

For retrodisplacement of the uterus the following treatment should be tried: If the uterus is displaced at the end of the third week of the puerperium it should be replaced and the knee-chest posture twice a day recommended. If the uterus is displaced at the end of six weeks it should be replaced, a suitable pessary inserted, and left in place for eight weeks.

During this time the patient should be placed in charge of an expert masseuse and should practice Swedish movements of the trunk and thighs (resisted), followed by abdominal massage. At the end of eight weeks the pessary is removed. Examinations are

Fig. 741.—The insertion of a pessary. It is turned almost upside down and inserted obliquely in the vulvar orifice. As it is pushed upward and backward it is rotated into proper position; this movement brings the back bar in front of the cervix; the forefinger slipped over it pushes it backward over the cervix into the posterior vaginal vault.

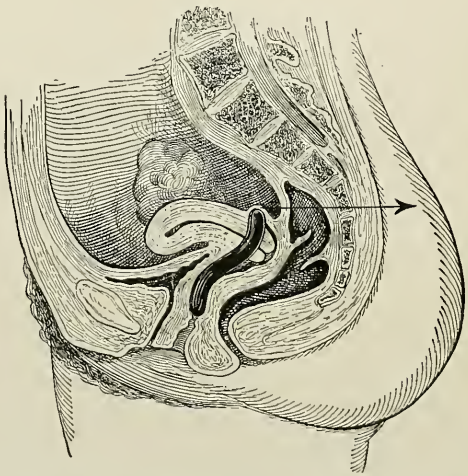

Fig. 742.—The retroversion pessary in position. The arrow shows the direction of the traction of the posterior vaginal wall upon the cervix.

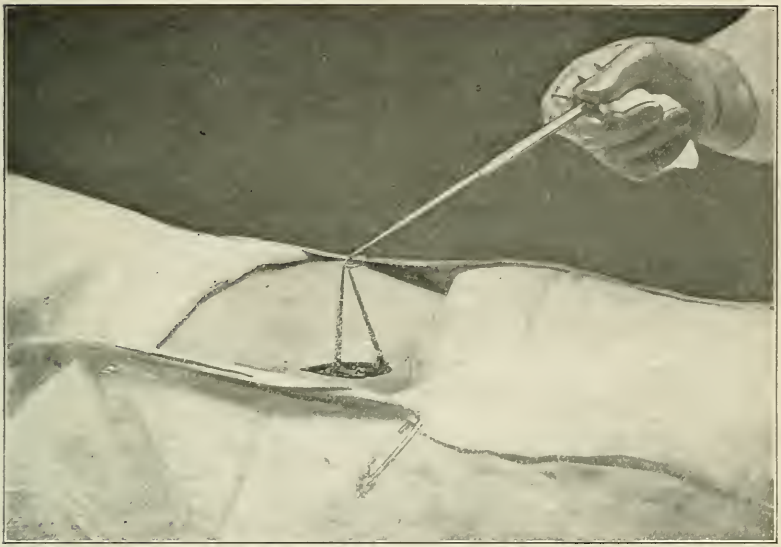

Fig. 743.—Round ligament freed, but not yet detached.

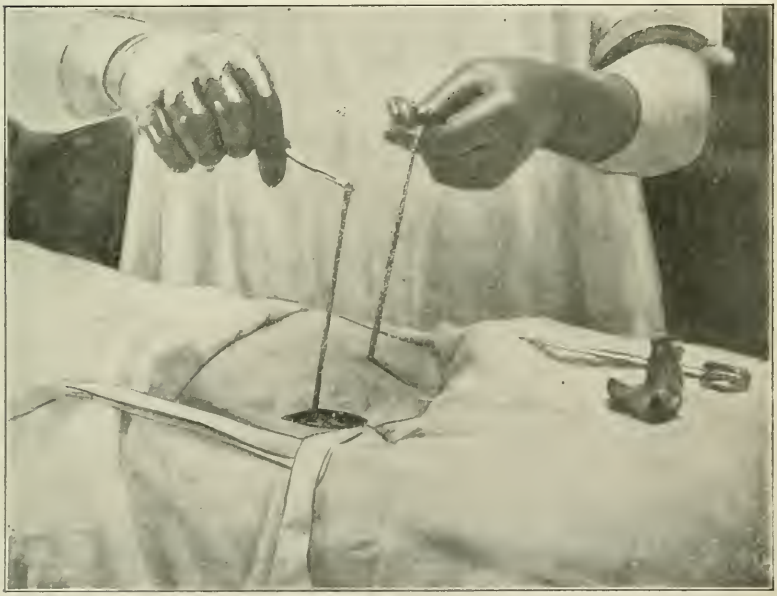

Fig. 744.—Round ligaments pulled out of inguinal canals four to six inches.

made at intervals of two weeks, a month, and two months. If at this last examination the uterus still remains in good position without artificial support, the patient is probably cured, although more liable to retrodisplacement of the uterus than the average woman. If the displacement recurs within three months after the removal of the pessary, the patient must choose between its indefinite use and a radical cure by operation.

Of all the operations for retrodisplacement of the uterus, more can be said in favor of shortening the round ligament in the groin

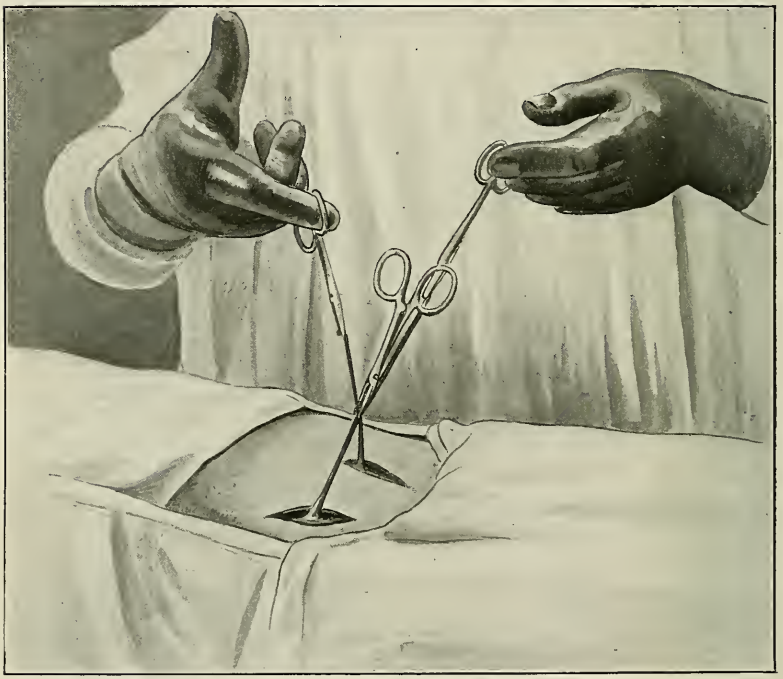

Fig. 745.—Round ligaments crossed and fastened together in mid-line.

than of any other.[1] In fifteen years and in more than 100 operations I have not seen a single recurrence, though some of my patients have had three children since the operation; no one anywhere has ever reported a serious disturbance of a subsequent pregnancy on account of the operation, and it is entirely free from risk. It can be performed at any time after the fourteenth to seventeenth day of the puerperium. As much cannot be said for any of the

[1] Proposed by Alquié in 1840; performed by Alexander in 1881 and described in 1883; performed and described by Adams in 1882. Hence, it is sometimes referred to by the clumsy title of the "Alquié-Alexander-Adams operation."

other operations. Unfortunately, it is only to be recommended if there is no suspicion of intrapelvic adhesions or disease, or of appendicitis.

The operator places his forefinger on the pubic spine, his thumb on Poupart's ligament, about an inch and a half intervening between the two. The points of the forefinger and of the thumb are then moved upward about a quarter of an inch and an incision through the skin is made between them. The fat and superficial fascia are divided to the deep fascia. Several blood-vessels are severed, the bleeding ends of which must be seized by hemostats. All the

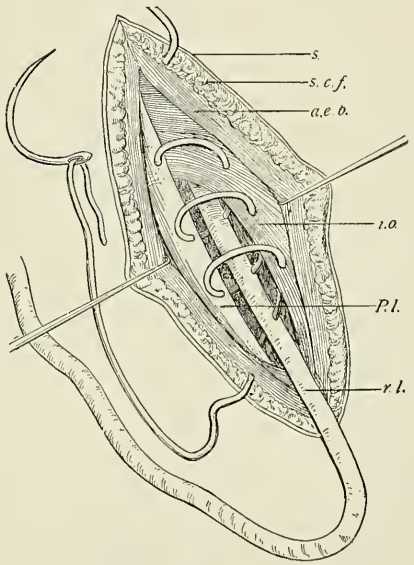

Fig. 746.—Deep tier of buried running suture of formalin catgut, embracing internal oblique and transversalis muscles, round ligament, and Poupart's ligament. Deep part of uppermost loop of suture (not showing in cut) passes at level of and embraces margins of internal ring: *s*, Skin; *s. c. f.*, subcutaneous fat; *a. e. o.*, aponeurosis of external oblique; *i. o.*, internal oblique muscle; *r. l.*, round ligament; *P. l.*, Poupart's ligament.

bleeding must be controlled before the deep fascia is opened, otherwise the difficulty of finding the round ligaments is much increased. The fascia is incised just above Poupart's ligament, the incision running through the pillars of the external inguinal ring. On the position of the incision depends the ease with which the round ligaments are found. If it is too high, they may not be located at all, or only with such difficulty and delay that the operation is scarcely justifiable. The inguinal canal being laid open by the division of the fascia, the edges of the wound are retracted with

forked retractors. The round ligament is at once seen as a whitish or pinkish cord about as large as a slate pencil, running along the floor of the canal. It is picked up by a blunt hook and gently drawn out of the internal ring, the genitocrural nerve which accompanies it being avoided. The peritoneal investiture which soon appears is stripped back by a gauze pad and the ligament is pulled out until it is freed for at least four inches. It becomes thicker and stronger as it emerges from the internal ring, until it may reach almost half the caliber of one's little finger. One ligament being extracted, the wound is covered with a gauze pad and the other groin, opposite the operator, is opened in the same way, except that if the operator stands on the patient's right hand, the thumb of his left hand marks the position of the pubic spine and the forefinger is placed upon Poupart's ligament about one and a half inches away.

Difficulty may be encountered in finding the round ligaments if they are small and ill-developed, if they pursue an abnormal course outward and upward, or if they are abnormally placed above their usual situation and behind the oblique muscle.

Both ligaments being freed as far as possible (at least four inches, oftener more), they are pulled upon by an assistant, while the operator lays his outspread hand upon the hypogastrium, against which he feels the fundus uteri bump as the ligaments are pulled upon. The terminal ends of the ligaments are cut off, they are crossed in the middle line over the mons veneris, and a hemostat fastens them both where they cross to insure an equal amount of traction on each when they are sewed fast in the inguinal canal.

The sutures are now inserted. A strand of catgut (size No. 1) on a curved needle is passed through the fascia at the upper angle of the wound, the end remaining loose, not knotted; the needle then passes through the internal oblique muscle, goes through the center of the round ligament, picks up the floor of the inguinal canal, and finally passes through Poupart's ligament. Four or five turns are thus taken, in the same order, each one passing through the center of the round ligament until the external pillars of the ring are united. The next turn of the needle passes under the round ligament, obliterating the external ring from above downward. All the redundant portion of the round ligament is cut off; the same needle and thread are then passed through the fascia alone midway between the turns of the continuous suture already in place, until the suture ends opposite the point where it began and is knotted in a triple knot, the only one required. The superficial fascia and fat are joined by a continuous fine catgut suture in two tiers. The skin is united by a continuous suture of catgut or an intracutaneous stitch, as the operator prefers. The groin wound nearest the operator

being closed, the other one is treated in the same way, except that a right-handed man naturally passes the needle in reverse order through Poupart's ligament, floor of inguinal canal, round ligament, oblique muscle, and fascia. As the round ligament is sewed in place an assistant holds the hemostat, keeping it in the middle line of the mons veneris, so as to insure equal traction on both sides. The wounds are covered with gauze and collodion. It is safer, but not necessary, to insert a pessary before shortening the round ligaments, which remains in place for six weeks after the operation. A convenient time to insert the pessary is after the curetment, which ordinarily precedes an Alexander operation, for almost every case of retroversion is complicated by a chronic endometritis with menorrhagia and leukorrhea.

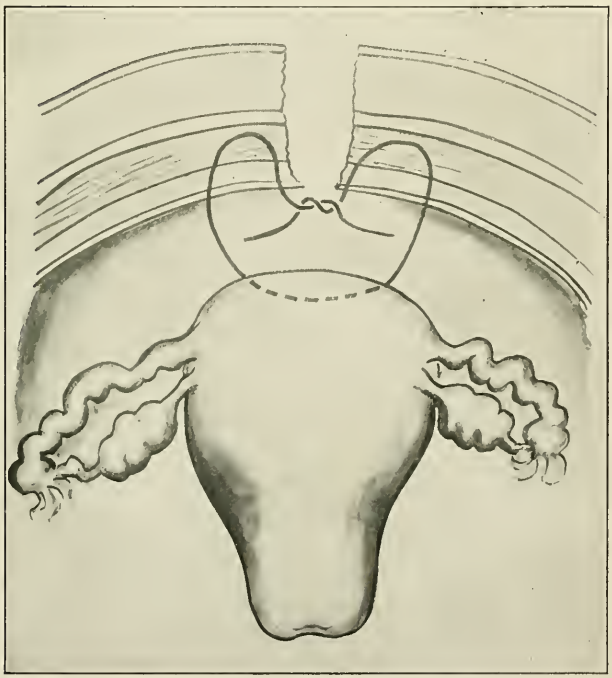

Fig. 747.—Suspension suture through fundus uteri, peritoneum, and a part of the recti muscles.

Abdominal Operations for Retrodisplacement of the Uterus.—Of the numerous operations devised for the purpose, the author avails himself now of only two—namely, uterine suspension and the Baldy operation.

Uterine Suspension.[1]—While this operation has been so generally available that it has been more frequently utilized than any other,[2] it has many objectionable features: The attachment of the fundus uteri to the abdominal wall is unnatural; the suspensory ligament if made too weak will not maintain the uterus in good position long and does not survive a subsequent pregnancy; if, on the contrary, it is made too firm (uterine fixation), there may be serious, even fatal complications, in a subsequent pregnancy or labor. Nevertheless, it is quick, easy to perform, and has fulfilled its purpose fairly well, so that its vogue has been extensive until something better is devised to supplant it. The technic of the operation is as follows: After opening the abdomen, two stitches of fine celloidin linen thread are passed through the peritoneum, a part of the rectus muscle, the perimetrium, and about an eighth of an inch of the myometrium of the fundus, as illustrated in Fig. 747. As these stitches are tied so that the knot falls within the peritoneal cavity, an assistant holds two fingers back of the uterus to prevent the inclusion of a loop of bowel. The patient remains in bed three weeks and avoids violent strains, jolts, and jars for several months afterward.

The *Baldy operation*[3] utilizes the round ligament in an ingenious manner to hold and support the uterus in an anterior position. A hemostat pierces the broad ligament from behind under the ovarian ligament and close to the edge of the uterus. The forceps seizes the round ligament about an inch and a half to two inches from its origin at the cornu and pulls it through the hole in the broad ligament. The same is done on the other side. The loops of round ligament are approximated behind the uterus and are fastened to one another and to the posterior uterine wall in the middle line at about the junction of the upper and middle third of the corpus uteri with celloidin linen thread. If the point on the uterine wall is properly chosen, it is impossible to push the uterus back again into a posterior position after the sutures are tied. This operation utilizes the strong uterine end of the round ligaments, which play like a rope through a pulley, the latter being represented by the unyielding ovarian ligament. I have used this

[1] Olshausen was the first to perform a modern uterine suspension. Kelly introduced it in America after a visit to Olshausen's clinic. Sims, Kaltenbach, Koeberle, Schroeder, Hennig, and Tait had previously attempted to fasten the uterine fundus to the anterior abdominal wall. Boldt and Leopold, in 1890, passed the sutures through the uterine fundus instead of through the uterine cornua and ovarian ligaments, as Olshausen and Kelly originally did.

[2] Out of more than 700 operations for displacement, I have done it about 600 times.

[3] Baldy has employed this principle for about eight years, but has modified and improved the technic. Webster utilized the same principle, but in a less perfect manner, not joining the round ligaments behind the uterus.

operation in an increasing number of cases during the past two years and like it better the more I see of it.

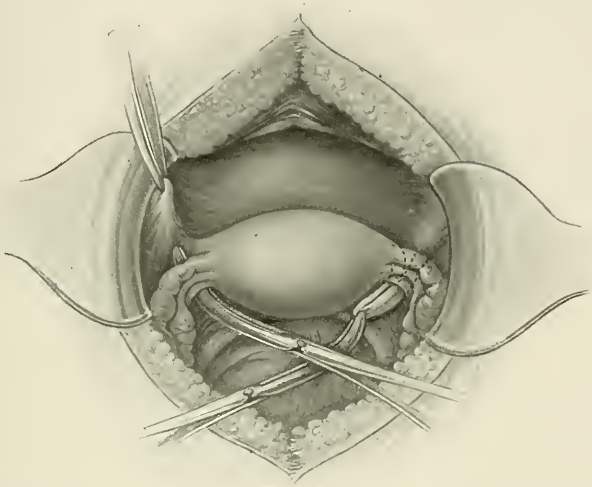

Fig. 748.—The Baldy operation: Round ligaments caught in the grip of a hemostat and pulled back through the broad ligament.

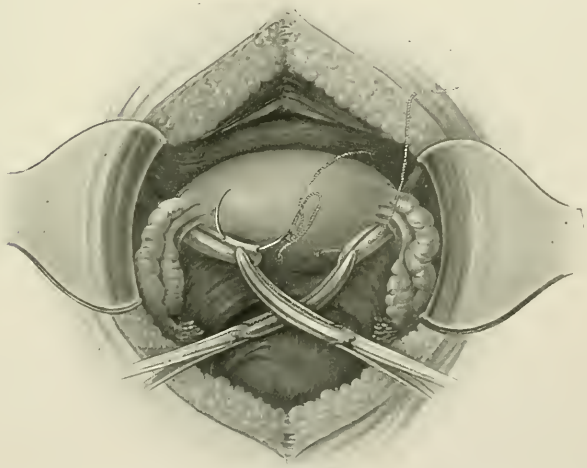

Fig. 749.—The Baldy operation: Round ligaments approximated in the mid-line posteriorly and united by a suture of linen thread.

The Operative Treatment of Diastasis of the Recti Muscles.—If the recti muscles gape more than four fingers' breadth after childbirth and if they afford insufficient support to the abdominal

wall, the patient should wear an abdominal supporter, should have electricity and massage applied to the abdomen, and should be put through a course of Swedish exercises. If, after some

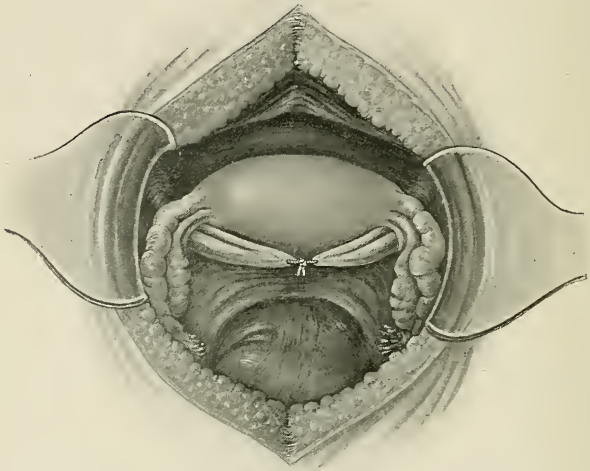

Fig. 750.—The Baldy operation : Round ligaments joined.

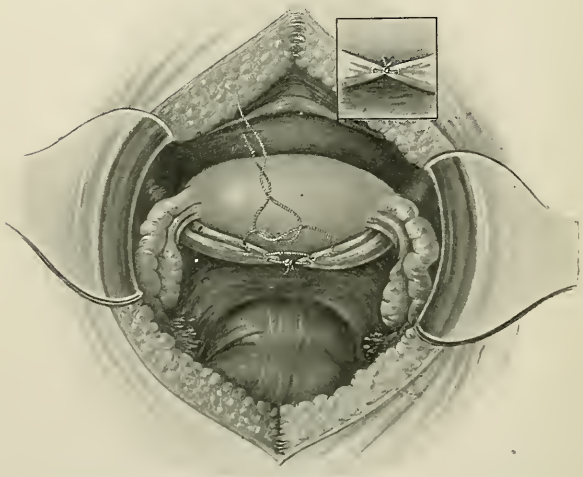

Fig. 751.—The Baldy operation : Round ligaments joined and fastened to the uterus.

months of treatment, the abdominal support is insufficient and if ptosis of the abdominal viscera begins to be manifest, operative treatment is indicated.

Webster has devised an operation for the purpose which is

satisfactory. Its technic is as follows: A long incision is made through the skin in the middle line of the abdomen, beginning well above the umbilicus and extending to the symphysis. The fat, superficial fascia, and skin are dissected back in one piece until

Fig. 752.—The "Storm" abdominal binder.

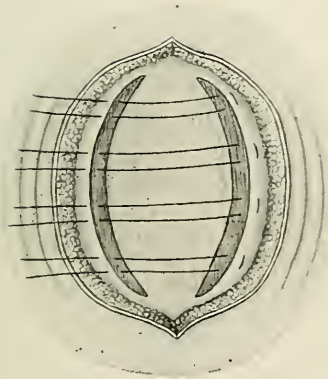

Fig. 753.—Webster's operation for diastasis of the recti muscles, modified. The sheaths of the recti muscles are split after dissecting back the skin and subcutaneous fat of the abdominal wall.

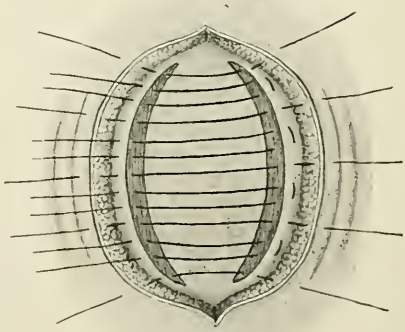

Fig. 754.—Webster's operation for diastasis of the recti muscles, modified. Mattress sutures of formalin catgut are inserted through the outer edges of the two sheaths, and silkworm-gut sutures are passed between them, through the skin, subcutaneous fat, and outer edges of the sheaths.

both recti are exposed. The anterior sheaths of the recti are split the whole length of the wound. The muscles are loosened by blunt dissection, the outer edges of each sheath are joined together in the middle line by interrupted and continuous chromic catgut

sutures, so that the intervening tissues are tucked into the abdominal cavity. The rest of the wound is closed and dressed as is any abdominal section.

Coccygectomy.—One of the coccygeal joints is frequently sprained in labor and the patient complains of pain for some time afterward, but the vast majority of cases are spontaneously cured within six months. If after that time pain persists so severe that the patient is seriously annoyed by it and if a physical examination demonstrates a rupture of a coccygeal joint, anchylosis of the bone in a straight line, or caries of one of the coccygeal vertebræ, coccygectomy is indicated.[1] The technic of the operation is as follows: An incision is made through the skin and fat over the middle of the bone, from above the two tubercles on the end of the sacrum to within a short distance of the tip of the coccyx, to keep the wound as far from the anus as possible. The edges of the wound are retracted with forked retractors. The coccyx is severed with scissors from all its attachments, except its junction with the sacrum. A Gigli saw is slipped under the coccyx, care being taken to place it above the alæ of the first coccygeal vertebra. The bone is sawed off, taking the extreme tip of the sacrum with it. The wound is closed with interrupted silkworm gut sutures, which must include the two fibrous bands on the back wall of the rectum and must obliterate all dead spaces. The wound is sealed with a collodion dressing.

[1] It is necessary to exclude hysterical pains in the coccyx, rheumatism, and the reflex coccygeal pain of a retrodisplaced uterus.

PART VII.

THE NEW-BORN INFANT.

CHAPTER I.

Physiology of the New-born Infant.

Respiration.—There are two factors which explain the institution of respiration: (1) External irritation, the result of a change of environment. The child is almost instantaneously transformed from an aquatic to a terrestrial animal, passing from a liquid medium, with a temperature of 99° F., to the air, with a temperature of 70° F., the shock of this sudden transition causing a reflex action of all the muscles, including those of respiration. (2) The maternal supply of oxygen being cut off from the fetal blood as the placenta is separated or compressed, there is an accumulation of CO_2, the primary action of which is that of a stimulant to the respiratory apparatus and to the brain-centers governing respiration. The power of the latter factor is often shown during or before labor. Should anything diminish the supply of oxygen to the fetal blood, such as pressure upon the cord, there is an immediate effort to respire. If the membranes are unruptured, liquor amnii is sucked into the lungs. If the head is in the vagina, or if air is admitted to the uterus after rupture of the membranes, respiration may be begun long before birth, and the child has actually been heard to cry aloud within the womb (*vagitus uterinus*).

The rate of respiration at birth is 44 to the minute, sinking shortly to 35.

The weight at birth is about 7 ½ pounds. There is a steady increase of about 1 ½ pounds each month before and 1 pound after the fourth month.

Month.	Weight, Pounds.	Month.	Weight, Pounds.
1	7·75	7	16
2	9·5	8	17
3	11	9	18
4	12.5	10	19
5	14	11	20
6	15	12	21

There is normally a loss of 5½ ounces, on the average, during the first two to five days, which is usually made up by the end of the first week. Some children, however, gain steadily from birth.

Digestion is accomplished by the digestive juices, except the diastatic ferment of the pancreas and of the salivary glands. It is partially dependent upon the bacteria normally present in the alimentary tract. A knowledge of the capacity of the stomach is important if one would avoid the common error of overfeeding a new-born infant.

The capacity of the infant's stomach is, on the average, during the first week, 46 c.c. (1.5 fl. oz.); second week, 78 c.c. (2.5 fl. oz.); third and fourth weeks, 85 c.c. (nearly 3 fl. oz.); third month, 140 c.c. (nearly 5 fl. oz.); fifth month, 260 c.c. (about 9 fl. oz.); ninth month, 375 c.c. (12.5 fl. oz.).

The greater the infant's weight, the greater the gastric capacity. One one-hundredth of the body-weight plus one gram each day is a fairly accurate formula for the expression of gastric capacity in the new-born. In a child of normal weight the capacity should be one ounce at birth and an increase of one ounce per month up to the sixth month, after which it is somewhat less (Holt).

The Position of Stomach.—Its axis is almost longitudinal, which in part explains the frequent regurgitation and vomiting of early infancy. It is placed high on the left side under the false ribs, so that it is influenced by the movement of the floating ribs in respiration.

Excretions.—The urine is albuminous for the first few weeks. The quantity is difficult to estimate. It is always acid in reaction. The specific gravity is low, 1003–5. A trace of sugar is often found in breast-fed infants and in those fed upon an artificial food containing sugar of milk. The urine is voided six to twenty times in twenty-four hours. It does not, as a rule, stain the diapers, and the mistake may thus be made of supposing none to have been voided.

The movements from the bowels consists for the first forty-eight hours of meconium, a substance greenish-black in color, and consisting mainly of bile-salts and coloring matter. Later, the evacuations become light yellow, are not formed, are sour in smell, acid in reaction, and have a slightly fecal odor. The normal frequency of evacuation is from three to four times in the twenty-four hours.

The temperature is always slightly elevated directly after birth. It then sinks a little below normal. Its subsequent course is marked by considerable irregularity, with the variations usually above 98°. Comparatively slight causes produce high temperatures.

The eyesight is always hypermetropic.

The pulse beats from 125 to 160 in the minute. It should be counted by listening to the beat of the heart, and not by feeling the pulse, as in an older child or adult.

The blood has a total bulk to the body-weight of 8 per cent.; there are six to seven millions red blood-corpuscles to the cubic millimeter; they are more spherical than in the older child, and do not tend to form rouleaux. Shadow corpuscles are abundant. White blood-corpuscles are more numerous, viscid, and deliquescent than in the adult. There is a large amount of hemoglobin

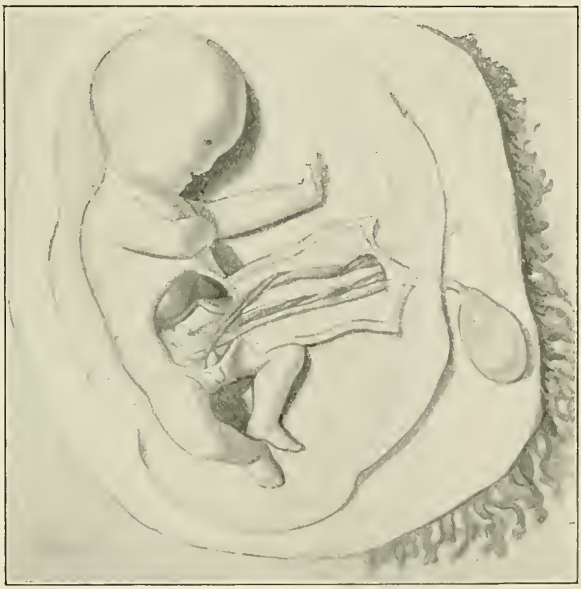

Fig. 755.—The circulation in the young embryo, before the atrophy of the umbilical vesicle.

at birth compared with the mother's blood—120.2 per cent. in the infant and 93.8 per cent. in the mother. At thirty-six to forty-eight hours after birth the percentage of hemoglobin is highest, and then begins to diminish.[1] The ordinary jaundice of the new-born infant is due to the superabundance of red blood-corpuscles which are destroyed in the liver, giving rise to an excess of bile-pigment. It is reasonable to suppose that it may also be in part hematogenic, the destruction of the red blood-corpuscles setting free a certain amount of coloring matter in the blood, which is directly absorbed by the tissues.

[1] Cattaneo, "Diss. Inaug.," Basel, 1892.

The heart exhibits a transition from the fetal to the infantile circulation by the closure of the foramen ovale, the obliteration of the ductus arteriosus and venosus, the obliteration of the hypogastric arteries, and the disappearance of the Eustachian valve (Figs. 755, 756).

The umbilical cord, after twenty-four hours, shows a line of demarcation at its base. There is then a necrosis of the amniotic covering, a mummification of the mucous tissue, and a destruc-

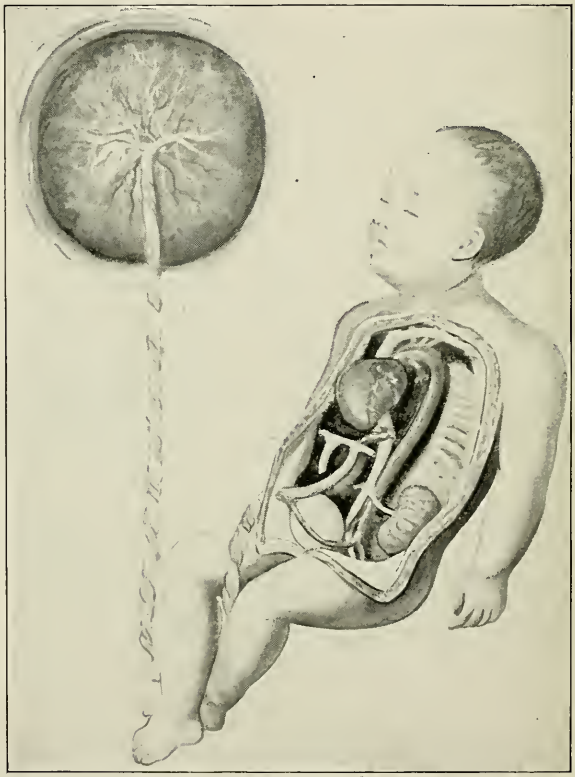

Fig. 756.—The circulation in the mature fetus before birth.

tion of its vessels. The cord drops off about the fourth day. Its detachment is followed by the retraction of the granulating stump within the umbilical ring.

Abnormalities in the Physiology of Premature Infants.—The two main deviations are low temperature—variations below 98°—and inability to ingest and digest food.

The management of premature infants consists of incubation and gavage. In the absence of a specially constructed incubator,

such as that represented in Figs. 757 and 758, one can be readily improvised with an ordinary infant's bath-tub, several layers of cotton-wool or lambs' wool, and a number of bottles filled with hot water. Gavage is the regular feeding of the infant with freshly drawn mother's milk through a small soft catheter passed into the stomach at each feeding. A more convenient and quite as efficient a plan is to draw the mother's milk with a breast-pump and to feed it to the child through a medicine dropper, a few drops being allowed to trickle into its mouth at a time. The

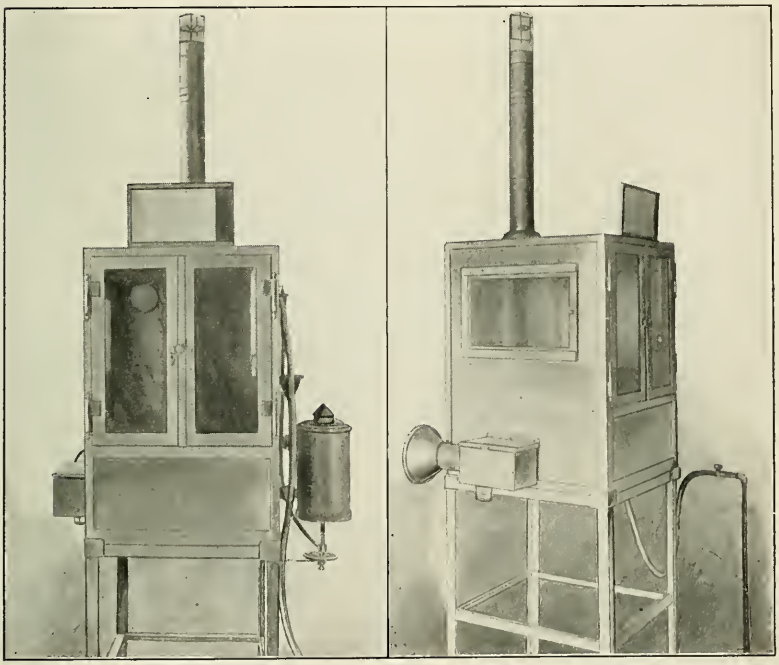

Fig. 757. Fig. 758.

Figs. 757 and 758.—The Kny-Scheerer improved incubator.

intervals between feedings should be an hour and the quantity administered should at first be no more than a dram. The child should not be bathed, but should receive, instead, a daily rub with warm oil. It should not be clothed, but should be buried in wool except its face. A diaper should be put under but not around the buttocks, and must be changed often enough to prevent chafing.

The mortality of this treatment has so much improved the chances of a premature infant that at six months, according to Tarnier's statistics, 22 per cent. are saved; at seven months, 38

per cent. are saved. Charles,[1] from an analysis of 932 premature births, found that at six months 10 per cent. were saved; at six and a half, 20 per cent.; at seven, 40 per cent.; at seven and a half, 75 per cent.

Sclerema is a disease of premature infants, seen most often in lying-in hospitals. The most prominent symptom is a hardening of the skin, beginning in the legs and spreading over the body, usually sparing the breast and abdomen. Jaundice or a hemorrhagic tendency often accompanies it. The temperature is very low, remaining at or below 95°. The pathology of the disease is not well understood. It has been ascribed to edema. The most probable explanation is that the large excess of stearin and palmitin in the subcutaneous fat of infants solidifies when the temperature falls below normal. The condition is a grave one and is likely to be fatal. The treatment consists in incubation, stimulation, and support.

The Management of the New-born Infant.—Clothing.—An infant should be clothed in winter as follows: A binder, of flannel or knit wool, twice around abdomen; a knit shirt, diaper, knit shoes, and two skirts, the first flannel (in midsummer, linen), and finally its dress. The skirts should be supported from the shoulders by sleeves or tapes. Each skirt should be made with a body, and not with a band. A knit jacket may be worn over the dress. A light flannel shawl or cap is desirable to protect the child's head from cold, when it is lifted from its crib or carried to another room.

As an infant urinates frequently, the diapers are changed about twenty to twenty-four times a day. The buttocks should be carefully dried and powdered with compound talcum, borated talcum, oxid of zinc and lycopodium, or rice-flour powder.

Feeding.—*Human Milk.*—The secretion is established at the end of forty-eight hours. It derives its origin from an overgrowth of epithelial cells lining the ducts of the mammary glands, their infiltration with fat, and subsequent rupture. The specific gravity is 1024–35, the reaction alkaline. Each minute fat-globule is surrounded by a pellicle of serum-albumin.

CHEMICAL CONSTITUTION.

	MEIGS.	VOGEL.	GAUTRELET.
Water	87.163	89.5	88.1
Fat	4.283	3.5	4.0
Casein	1.046	2.0	2.2
Sugar	7.407	4.8	6.2
Ash	0.101	0.17	0.5

[1] "Viabilité des nouveau nés à terme et avant terme," "Archives d'Obstet.," 1893, p. 412.

Fat.—This constituent of human milk is subject to wide variations in quantity under the influence of diet and general health. Under normal conditions, however, it stands quite constantly at four per cent.

Proteids of Milk.—The proteids of milk are casein and lact-albumin.

Casein.—Casein is, strictly speaking, the curd of milk, formed by a digestive ferment acting upon "caseinogen," a proteid analogous to fibrinogen, myosinogen. Caseinogen is a peculiar substance, neither an alkali-albumin nor a globulin, but occupying a distinct position among proteids.

Lactalbumin.—A proteid resembling closely serum-albumin, but somewhat different from it. It is present in small quantities —one-half of one per cent. When the milk is curdled, a new proteid appears in whey, called "whey-proteid," which is soluble and non-coagulable by heat.

The sugar is lactose; it is not strong in sweetening properties.

The ash of human milk is made up mainly of potassium, sodium, calcium, and phosphoric acid.

The quantity of milk at each nursing is difficult to determine. It may be estimated by: (1) The infant's gain in weight after each feeding. This is not constant, varying from three to six ounces. (2) The capacity of the infant's stomach. (3) The quantity secreted in twenty-four hours, divided by the number of nursings. At the end of the seventh day the quantity in twenty-four hours is fourteen ounces; at the end of the fourth week, two pints.

If the mother can not nurse her child, the best substitute, theoretically, is a wet-nurse.

The selection of a wet-nurse should be governed by the following considerations:

She should have *milk of good quality*, which is best judged by the appearance of her own child.

She should, preferably, be a multipara, and of suitable age; her child should be, approximately, the same age as the one to be nursed; her nipples should be well shaped; and it is an advantage to have made a chemical analysis of her milk.

She should have an equable disposition and an absence of disagreeable qualities.

Above all, *she should not have syphilis.* As a matter of fact, wet-nurses are so inconvenient and disagreeable in the average household, and the results of artificial feeding have so markedly improved, that the vast majority of children who are not nursed by their mothers are raised on the bottle.

Artificial Feeding.—Asses' and goats' milk are more like

human milk than is cows' milk, but, as they are not conveniently procurable, the last is universally used. To appreciate why so large a proportion of artificially fed children die annually, particularly in the hot summer months, it is sufficient to glance at the differences between cows' and human milk.[1] The most important differences may be briefly tabulated as follows:

Gross Appearances.—Cows'—a dead white in color, and opaque. Human—often yellow; sometimes bluish. More translucent.

Reaction.—Cows'—acid. Human—alkaline.

Specific Gravity.—Cows'—1030–35. Human—1024–35.

Curd Comparison.—The coagulum produced by a digesting ferment, as rennet, is dense, tough, and digested with difficulty in cows' milk; light, flocculent, and easily digested in human milk.

This difference is due merely to the larger quantity of caseinogen in cows' milk, and to the acidity. Dilute cows' milk and make it alkaline, and the curd, on the addition of rennet, is as light and flocculent as in human milk.

Chemical Comparison.—Cows' milk contains more casein and less sugar.

Comparative Analyses.

	Meigs.		Vogel.	Lehman.	Gautrelet.	
	Human.	Cows'.	Human.	Cows'.	Human.	Cows'.
Water	87.16	87.1	89.5	87.5	88.1	85.61
Fat	4.28	4.20	3.5	3.5	4.0	4.0
Casein	1.04	3.25	2.0	3.5	2.2	3.5
Sugar	7.40	5.0	4.8	4.8	6.2	6.0
Ash	0.10	0.52	0.17	0.75	0.5	0.85

Histological Comparison.—It is asserted that the albuminous envelope surrounding the fat-globules is thicker and tougher in cows' milk. Colostrum-corpuscles are found in human milk, normally, up to the eighth or tenth day. They return under influences interfering with lactation, as heretofore described.

Bacteriological Comparison.—Human milk comes from the breast practically sterile. Cows' milk in cities, particularly in hot weather, after twenty-four hours, swarms with all kinds of pathogenic and non-pathogenic micro-organisms and their products, some of which are virulent toxins.

Quantitative Comparison.—Human milk is furnished in quan-

[1] According to official statements relating to the Russian foundling hospitals at St. Petersburg and Moscow, about 1,000,000 newly born children have been given over to them during the last hundred years, most of them illegitimate. Of this large number, nearly 800,000 have died in the first months or first years of their existence. A well-known authority on statistics satirically calls it "chronischer Kindermord auf Staatskosten" ("chronic infanticide at the cost of the State").

tity and at intervals suitable for the infant. Artificially fed children are often overfed.

Preparation of an Artificial Food.—In making an artificial food with cows' milk as a basis, three factors must be borne in mind: the quantity required, the differences in chemical composition and reaction, and the microbic infection. The first may be regulated by the following table, based upon a study of the capacity of the infantile stomach:

Age.	Interval.	Number of Feedings in Twenty-four Hours.	Amount of Food at Each Feeding.	Total Amount in Twenty-four Hours.
First week	2 hrs.	10	1 oz.	10 ozs.
Second to fourth week	2 "	9	1½ ozs.	13½ "
Second to third month	3 "	6	3 "	18 "
Third to fourth month	3 "	6	4 "	24 "
Fourth to fifth month	3 "	6	4–4½ "	24–27 "
Sixth month	3 "	6	5 "	30 "
Eighth month	3 "	6	6 "	36 "
Tenth month	3 "	5	8 "	40 "

The difference in chemical composition and reaction may be removed by diluting the whole to reduce the casein, adding cream and milk-sugar, and making the mixture alkaline. The microbic infection of cows' milk may be obviated by pasteurization.[1] The following formula accomplishes these purposes:

Milk for one bottle	4 drams
Water (boiled)	5 "
Cream	1 dram
Lime-water	1 "
Milk-sugar	20 grains.

To pasteurize the milk, six bottles should be made up for the ensuing twelve hours.

Stopper the mouth of each bottle with dry, baked cotton; put them in an Arnold's pasteurizer; raise temperature to 170°. Put on hood and let stand off the stove for thirty minutes.

Set aside to cool and then put in a refrigerator.

Apply a plain rubber nipple to the bottle before use.

Warm it to blood heat in a warming cup before giving it to the child.

Cleansing.—The infant should receive a daily bath in the middle of the day in the warmest part of the room. The temperature of the water should be not much over 90°. The nurse, whose hands are commonly insensible to hot water,

[1] By this term is meant the subjection of the milk to a temperature of 167°–175°, which sterilizes it but does not impair its nutritive value as steam sterilization or boiling does.

should be required to use a bath thermometer. Castile-soap and a soft sponge should be used, and care must be exercised not to irritate the eyes. For the first week the child should be simply sponged on the nurse's lap. After that, if it is strong and vigorous, it may be immersed in the tub.

Airing.—In summer the baby may be taken out after the second month; in winter after the third month, for a short time, in the warmest part of the day.

The resting place should be a crib, and not a cradle.

CHAPTER II.

Pathology of the New-born Infant.

INJURIES TO THE INFANT DURING LABOR.

(*Classified According to the Seat of Injury.*)

The first four weeks of life show the highest mortality. About 10 per cent. of the children born die of immaturity, asphyxia, atelectasis, malformations, injuries and infection.[1]

Brain.—Injury to the brain is most frequently the result of the faulty use of forceps or of the violent extraction of the after-coming head. It may be a meningeal hemorrhage, varying in extent from the rupture of a small vessel and a slight extravasation of blood to the laceration of the longitudinal sinus and a fatal intracranial hemorrhage. If less in degree, the child may live to adult age, but is apt to show impaired physical or mental development. The brain-substance may be crushed. Injuries may be inflicted upon the brain not so grave, but affecting intellectual or physical centers, and the subsequent mental or physical development of the individual. There may be simply compression of the brain, causing perhaps asphyxia.

Persistent priapism may be seen occasionally, as a result of injury to the brain or cord.[2]

Peripheral Nerves.—The facial and brachial plexuses are the peripheral nerves most frequently damaged. The majority of cases of facial hemiplegia are due to the faulty use of forceps

[1] Based on the statistics of 1,439,000 births (Snow, "Archives of Pediatrics," September, 1903).

[2] In one of my cases priapism persisted for two weeks, to the dismay of the mother, who feared it would be permanent.

Recovery may be expected, usually in the course of a week. Should this fail to occur, the faradic current may be used with advantage. Facial palsies at birth are usually unilateral and transitory ; they may, however, be bilateral and permanent. *The brachial palsies* result from unskilled attempts at extracting the shoulders and arms, and are likely to be permanent.

Skull.—Spoon-shaped depressions of parietal or frontal bones may be caused by a prominent promontory or by forceps. It has been suggested to elevate the depression by pneumatic traction or by trephining.

Fractures, if compound, require an aseptic dressing. Recovery, even from so grave an injury, sometimes occurs.

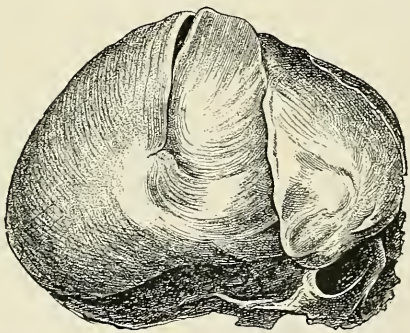

Fig. 759.—Spoon-shaped depression and fracture of a parietal bone (Winckel).

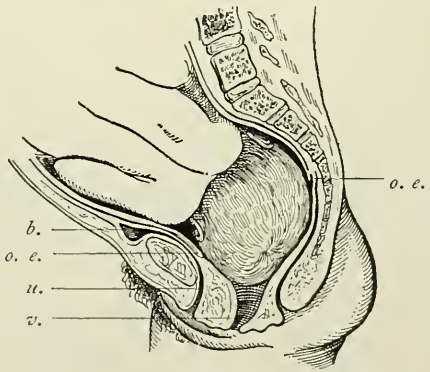

Fig. 760.—Formation of caput succedaneum : *o. e.*, External os ; *b*, bladder ; *u*, urethra ; *v*, vagina.

Distortion of the head is very common, almost constant. Its variations in form are the result of the different presentations and positions. The deformity, even though very marked, disappears within the first three days (Figs. 761–766).

Fig. 761.—The undistorted head of a breech presentation (Schroeder).

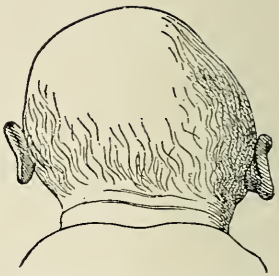

Fig. 762.—Right occipito-posterior position of the vertex (Schroeder).

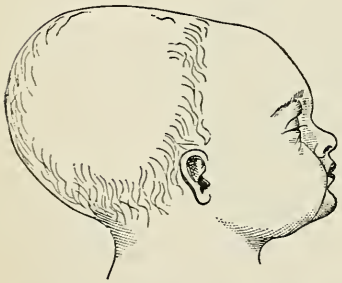

Fig. 763.—Normal vertex (Schroeder).

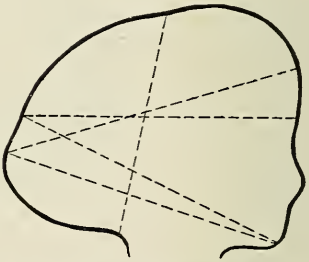

Fig. 764.—Outline of head after delivery, the brow presenting (Budin).

Fig. 765.—Brow presentation. (Schroeder).

Fig. 766.—Face presentation (Schroeder).

Scalp.—Caput Succedaneum.—A serous infiltration of that portion of the presenting part corresponding to the external os. It disappears in two or three days, and requires no treatment.

Cephalhematoma is a more important condition, and is to be distinguished from a caput succedaneum. It occurs about once in two hundred cases. Usually two or three days after birth a swelling develops, rapidly increasing in size, possessing the physical signs of a cystic tumor, distinctly confined by the boundaries of one of the cranial bones. It may be bilateral. It may occupy the parietal and the occipital bones, and it may possibly develop

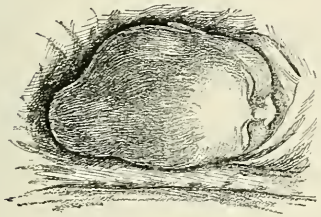

Fig. 767.—Cephalhematoma.

Fig. 768.—Double cephalhematoma.

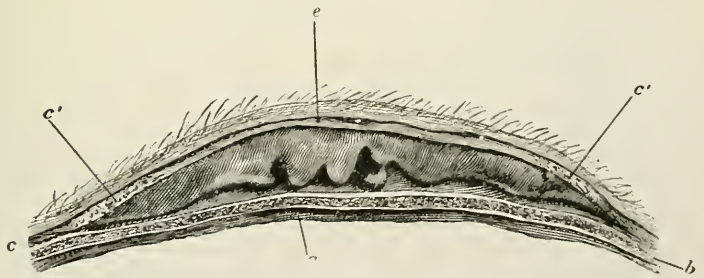

Fig. 769.—Longitudinal section through a cephalhematoma: *a*, Dura mater; *b*, cranium; *c*, pericranium; *c'*,*c'*, beginning hyperostosis; *e*, scalp (Davis).

before birth. It is due to a subpericranial hemorrhage, which lifts the pericranium from the bone, irritates it, and stimulates it to bone-production, thus giving rise to a bony sensation at the lifted edges of the pericranium, and later to a peculiar crackling or crepitus over the surface of the tumor, due to the movement of the thin bone-plates on one another. Non-interference is the

treatment, except when the hemorrhage is excessive or suppuration occurs. The former may be controlled by pressure and cold; the latter requires incision and drainage, with strict asepsis. In spite of the greatest care, septic meningitis may develop.

Contused and *lacerated wounds*, usually the result of a forceps operation, are to be treated on general surgical principles.

Sloughs.—The vitality of the scalp may be destroyed by forceps or by prolonged pressure from the pelvic bones, and sloughs may appear in the first few days after birth. They require the ordinary surgical treatment for the same condition anywhere on the body.

Fig. 770.—Child in face presentation.

Face.—A caput succedaneum may occupy the face if it presented in labor. The eyes and the mouth may be injured by careless examinations or by violent extraction of the after-coming head. The former may be injured by the forceps. The globes may be luxated to complete exophthalmos; the recti muscles may be permanently paralyzed; there may be subconjunctival or palpebral ecchymoses, edema of the lids, and temporary ptosis; fracture in the roof of the orbit; exudation of blood into the anterior chamber. The cheeks, temples, and forehead may be bruised, crushed, or cut by forceps. Hematomata may develop in the cheeks within twenty-four hours of birth. The blood-tumors should be let alone, as in the case of a cephalhematoma.

Neck.—There may be injury and thrombosis of the neck-muscles, with reactive inflammation, most frequently of the sternocleidomastoid, with the development of torticollis. This sort of wry-neck usually recovers without treatment.

Fracture, Dislocation, or Decapitation.—The author has been told the details by eye-witnesses of three cases in which the head was pulled off after version. In each instance Cesarean section

was done to extract the head. The women all died. Craniotomy should obviously have been the operation for the extraction of the head.

There is occasionally injury to the cervical spine and to the larynx and trachea, in consequence of the excessive twisting of the neck that occurs when the occiput turns forward from a posterior position and the shoulders do not follow the movement of the head.

Limbs.—Fractures, which are usually a separation of diaphysis and epiphysis, require, in the case of the lower extremities, surgical fixation, extension, and a plaster bandage. In the case of the arms, fixation in the Velpeau position by a jacket with only one arm-hole, for the sound arm. Union is prompt. Fractures are usually the result of faulty management on the physician's part, but they may be spontaneous. Avulsion of the

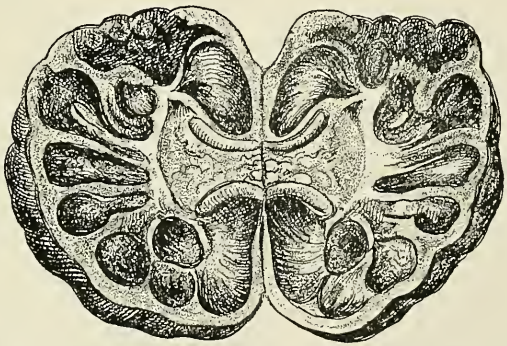

Fig. 771.—Visceral hemorrhages into the kidney (author's case).

limbs sometimes occurs in efforts to extract a premature or macerated fetus.

In a case admitted to the University Maternity, both arms of a well-developed infant were pulled off in an attempt at version; the uterus was ruptured and two feet of ileum were pulled loose from the mesentery.

Trunk.—Perforations of the groin and perineum may be due to the use of a blunt hook or a forceps applied to the breech. There may be rupture of some important viscus, like the spleen, liver, or lungs, with fatal hemorrhage into the peritoneal or pleural cavities, especially in syphilitic children; or visceral hemorrhage may occur, as in the kidney, without actual rupture, but to a sufficient degree to abrogate the functions of the organ.

Fracture of the clavicle in extracting the after-coming head may result in the puncture of the lung by the broken end of the bone and in fatal emphysema. The kidney, spleen, and liver have been ruptured in attempts to extract the breech. Subcapsular hemorrhages in these organs are observed quite frequently. In the pleura there are often ecchymotic spots in asphyxiated children, with minute but multiple extravasations in lungs and brain. The pleura may be lacerated, with a hematothorax as the result.[1] The body may remain distorted for some time as the result of a face presentation, and there may be ecchymoses upon the body if there is a presentation of the trunk.

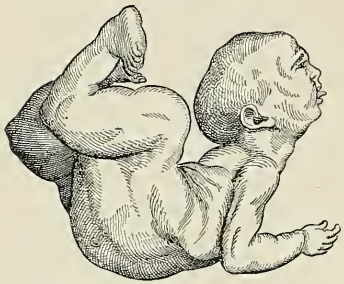

Fig. 772.—Child born in face presentation (Schroeder).

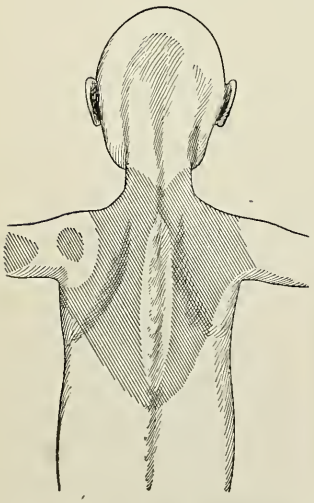

Fig. 773.—Back presentation. Disposition of the serosanguineous ecchymosis (Budin).

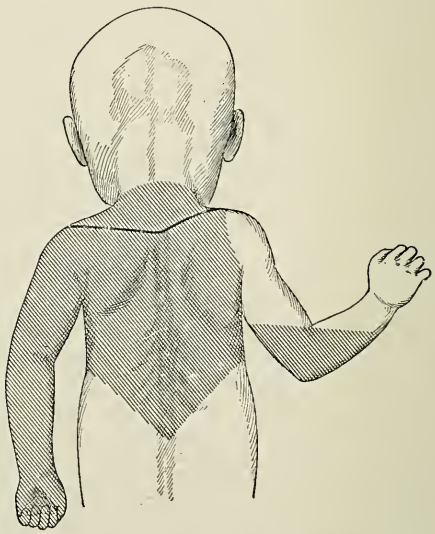

Fig. 774.—Fetus after a presentation of the back, shoulder, and elbow. Disposition of serosanguineous ecchymosis (Budin).

Bowel.—The large bowel may rupture from preëxisting ulceration or necrosis, usually at the sigmoid or other flexures.

[1] "Ein Fall von traumatischen Hematothorax beim Neugeborenen," "Z. f. G. u. G.," Bd. xxx, 1 und 2; Gebhard, p. 402. There was a rupture of an intercostal vein and of the pleura in attempts to extract a breech and trunk.

Asphyxia.—Asphyxia of the new-born child results in consequence of an insufficient supply of oxygen to the blood. To understand its causes it is necessary to review the

Physiology of the Institution of Respiration.—The sudden changes in the environment of the fetus (from a liquid medium at 99° to the air at 70°) produces an exaggerated stimulation of all the muscles to reflex action, including the muscles of respiration. Placental respiration is, moreover, abolished, and the accumulated CO_2 primarily stimulates, but finally paralyzes, the respiratory center.

The causes of asphyxia are:

First, intra-uterine. Under this head come—

Fetal inspiration.

Any interference with placental respiration, paralyzing the brain-centers, as premature detachment of placenta; coiling, compression, or prolapse of the cord; diminution of the caliber of the umbilical vessels, as from syphilitic periphlebitis; excessive and prolonged uterine contraction.

Prolonged pressure on the fetal brain by the pelvis or by forceps, paralyzing the brain-centers.

Grave systemic diseases of the mother, and accidents, including hemorrhage, uterine or pulmonary.

Anomalies or diseases of the fetus, preventing the entrance of air into the respiratory tract, or preventing the proper distribution of blood from right ventricle to the lungs, as a patulous foramen ovale or atresia of the pulmonary artery.

Second, extra-uterine causes, as—

Placing the infant after birth in a position unfavorable for respiration.

Precipitate labor.

Interference with the access of air to respiratory passages, as by a caul, unruptured membranes, or maternal discharges.

Asphyxia neonatorum is divided into two stages:

1. *Asphyxia Livida.*—In this stage there is an accumulation of CO_2 in the blood, yet the circulation continues and the reflexes are preserved. The prognosis of this stage is favorable.

2. *Asphyxia Pallida.*—This is an advanced stage of the former, characterized by weakness of the heart, slowing of its pulsations, and the abolition of the reflexes. The prognosis of this stage is naturally unfavorable.

Treatment.—If possible, asphyxia should be prevented by removing the possible causes during labor. The treatment of the condition after labor consists of:

1. Extraction of mucus from the throat and fauces by holding the child by the feet and cleaning the mouth with a finger.

2. The application of exaggerated stimuli to respiration,

as slapping of the buttocks, vigorous rubbing of the back and chest; immersing the body in warm water, and pouring ice-water on the epigastrium; applying electricity, if practicable, preferably in the shape of a faradic current, one pole being placed on the epigastrium and the other applied on the sternum, flanks, and thighs. The electric brush is most efficacious. In the pallid variety only the most powerful of these stimuli are useful.

3. Artificial respiration is induced by one or all of several methods.

Sylvester's is not to be recommended because the pectoral muscles of the infant are too weak to inflate the chest when pulled upon by the manipulation of the arms.

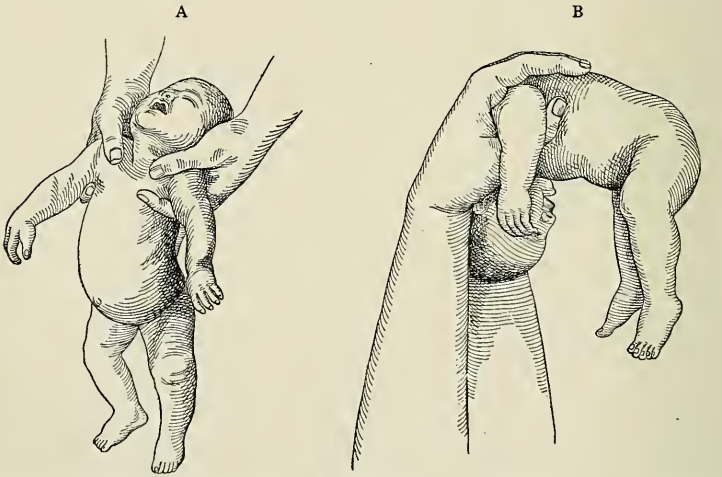

Fig. 775.—Schultze's method of artificial respiration: A, Inspiration; B, expiration.

Marshall Hall's method, modified to suit the requirements of the new-born infant by suspending it in a towel, and thus rolling it from side to side, is sometimes useful.

Byrd's method, flexing and extending the trunk, and holding the child upside down so that mucus may run out of its throat, is efficient.

Schultze's method is one of the best. The infant should be wrapped in a towel to protect it from being chilled, should be held as shown in figure 775, and should be swung between the physician's knees and over his shoulder; after practising the swinging movements fifteen to twenty times, the child should be immersed for a few seconds in warm water to raise its temperature, when the movements may be repeated.

Mouth-to-mouth insufflation ranks with Schultze's method,

or is superior to it. The exit of air from the lungs should be facilitated by placing the infant's neck over a mug or cup with the head extended, and after inflating the lungs flexing the head and compressing the chest. The nose should not be held to prevent the escape of air, as is sometimes advised. The physician draws a full breath and through a clean towel spread over the child's face blows the first part of the expired air into the child's mouth. The open nostrils serve as safety-valves. The air-vesicles of the lungs are not so likely to be damaged.

Catheterization of the larynx with a soft catheter and direct inflation of the lungs is only advisable if there is tumefaction of the neck or some other mechanical interference with the entrance of air into the larynx. Great care must be exercised not to injure the posterior wall of the trachea nor to catheterize the esophagus.

As a last resort, tracheotomy and catheterization through the wound may be required. It is only required in most exceptional cases.[1]

Risks Attending Artificial Respiration.—Injuries, as apoplexies; Schultze's method may injure the spine; hemorrhagic effusions in the pleuræ and lungs; rupture of the air-vesicles in insufflation; the trachea and larynx may be injured; the lung may be punctured if the clavicle is broken.

After-treatment of Asphyxia Neonatorum.—A child deeply asphyxiated and revived with difficulty will, more likely than not, die within forty-eight hours of birth. It should be carefully watched, therefore, for at least two days, in order to detect rapid respiration, feeble heart-action, and evidence of intracranial disturbance. It is a good practice to administer routinely to such children five drops of brandy and a drop of tincture of digitalis in hot water, every four or every two hours, to keep them swathed in cotton-wool, and possibly to surround them with hot-water bottles or bags, if their vitality is low.

DISEASES OF THE NEW-BORN INFANT.

Diseases of the Lungs.—Atelectasis.—The *causes* are not known. Sometimes it may be due to obstruction of the air-passages, as by an enlarged thymus, a clot of blood, curd of milk, etc.

The *diagnosis* is usually not made during life. Dullness on percussion might be detected on one side if the atelectasis were

[1] I was obliged to resort to this treatment in a case of face presentation with such distortion of the neck that mouth-to-mouth insufflation and catheterization of the larynx were impossible. The child was kept alive for an hour, but would make no attempt at respiration.

unilateral. The respiration is accelerated and imperfect. There is an absence of fever. The symptoms are present at birth.

Pathological Anatomy.—One lung is found shriveled up, is not crepitant, and sinks when placed in water.

The *prognosis* is necessarily grave.

Treatment.—If the diagnosis is made, gentle insufflation of the lung with a catheter might be attempted.

Syphilis of the Lung.—The diagnosis may be made by a history of syphilis in the parents, by the signs of fetal syphilis, together with the cyanosis and physical signs of pneumonia. The temperature is very low, suggesting the use of an incubator. Treatment, however, is of no avail, the child usually dying within twenty-four to thirty-six hours.

Pathological Anatomy.—An enormous overgrowth of connective tissue is found, compressing the blood-vessels and diminishing the capacity of the air-vesicles. As some air has entered the lung, a cut-off portion never sinks, but does not float buoyantly. The "white pneumonia" of syphilitic infants is rare. It is the result of proliferation, desquamation, and fatty degeneration of the epithelial cells in the lungs, giving the latter a white appearance, and distending them so that the thoracic cavity is well filled out and the lungs bear the imprint of the ribs. Respiration is impossible.

Septic infection of the lungs is common. It is the result of inspiration of septic matter from the vagina or from the decomposition of inspired blood-clots or vaginal discharges.

Tuberculosis may be caused by mouth-to-mouth insufflation on the part of a tuberculous person.

Pneumonia of the new-born is usually caused by the inspiration of maternal discharges, resulting from intra-uterine respiratory efforts when asphyxia is threatened. The result is usually an infection of the lungs, septic pneumonitis, and a general blood infection. Blood cultures usually demonstrate streptococci.

Pneumonia arising from this cause develops about twenty-four hours after birth, in a child apparently healthy, the temperature at this time beginning to rise and the respiration growing more rapid. Cough, although a variable symptom, is occasionally incessant. The child is restless, refuses the nipple, is cyanotic, at times gasps for breath, and there may be dullness over one or both lungs. The diagnosis can not always be made by the physical signs; only a small patch may be involved. There is usually a history of dystocia. When a new-born infant has a high temperature, septic pneumonia and general infection should be suspected as the most probable causes of the fever.

The *prognosis* is grave.

The *treatment* should consist of stimulation—gr. ¼ to ½ carbonate of ammonium in 5ss–5j mucilage of acacia every four hours if it does not irritate the stomach. Tincture of digitalis, in drop doses, should be given every two or four hours. A mustard-bath once, twice, or thrice daily[1] is an important item in the treatment if there is cyanosis and very rapid respiration. A cotton jacket should be applied. The mother's milk should be drawn from the breast and fed to the infant from a medicine dropper in small quantities every two hours; a few drops of brandy may be added to it.

Pulmonary apoplexy is a rare accident in young infants, the result of severe straining in crying or coughing. There is hemoptysis, the quantity of blood lost usually not being very great, though it stains the front of the dress and alarms the child's caretaker exceedingly. The prognosis is favorable.

Syphilis of New-born Infant.—*Symptoms.*—The child is often ill-developed and ill-nourished, but the characteristic signs of the disease do not usually appear before four or six weeks. In the order of their diagnostic value these signs are:

Coryza syphilitica. The discharge from the nose is irritating to the upper lip, and frequently produces crusts and even ulceration.

Maculopapular syphilide; roseola, especially marked on the heels; cutaneous papules and mucous tubercles; rhagades oris et ani; pemphigus; cutaneous ulcers; paronychiæ; pseudo-paralyses of extremities, due to infirm connection between diaphysis and epiphysis, or to painful periostitis which inhibits motion; hemorrhagic diathesis; bone diseases; fever; disease of the testicles, which are enlarged from the overgrowth of connective tissue.

Treatment.—The best results are obtained from the internal use of calomel with chalk or soda, $\frac{1}{12}$ of a grain given twice a day, gradually increasing the dose. Should vomiting or diarrhea occur, mercurial inunctions must be employed, rubbing a piece of mercurial ointment as large as the end of the little finger on the child's abdominal binder every other day.

This treatment should be kept up intermittently for months, being replaced from time to time by tonics, as drop doses of syrupus ferri iodidi. The child's food requires careful attention.

Prognosis.—If the child is well nourished by its mother or by a wet-nurse, the prognosis is very good, so long as some impor-

[1] The bath is made as follows: Three large pitcherfuls of water at 100° F., and a tablespoonful of mustard; allow the child to remain in the bath for five minutes, or until the temperature of the latter falls to 95°, when the infant should be removed and wrapped, undressed, in a warmed blanket, in which it remains for a half hour.

tant internal organ is not seriously affected. In artificially fed children the prognosis is unfavorable. The wet-nurse is liable to be infected, and she should not be ignorant of her danger.

Mastitis.—Four days after birth the breasts in both sexes contain colostrum, which has disappeared by the twentieth day. During this period there may occur in the breast of the child pathological processes like those in the breast of the puerpera. The breasts may enlarge and become painful; the skin over them may be an angry red; the secretion may be much increased, so that the milk runs out in a stream, and even a mammary abscess may develop.

Treatment.—The nurse must avoid squeezing the glands. Cooling lotions should be applied, and the skin should be oiled, to relieve tension. If suppuration occurs, the abscess should be incised without delay, as there is always a tendency for the pus to burrow inward toward the pleura.

Specific or Essential Fevers.—Exanthemata.—The infant may exhibit the exanthem at birth or may contract the disease subsequently. The treatment is the same as under other circumstances.

Septic infection occurs by inspiration of infected discharges from the vagina during birth or through the umbilicus. The most important treatment is the preventive (see Diseases of Umbilicus). The infection of the umbilicus usually occurs in the first two weeks of life, but the symptoms may appear as late as the fourth week.

The Treatment of Certain Congenital Deformities.—Hare-lip.—This deformity may prevent suckling; if so, an immediate plastic operation is indicated, which may be undertaken in the first few hours of life.

The operation for **cleft-palate** is too serious to be undertaken during early infancy. A rubber flap over the nipple of the bottle may enable the child to suck. It can not nurse from the breast.

Supernumerary digits should be ligated and cut off. If they are mere fleshy appendages, a thread may be tied around their base, and they may be left to fall off.

In a **tongue-tie** the frenum should be snipped superficially with blunt-pointed scissors, and then torn with the fingers to the floor of the mouth. The child's head is placed between the knees of the operator; the two first fingers of the left hand are inserted on either side of the frenum, to hold the mouth open and to protect the tongue from injury.

Umbilical Hernia.—There are two varieties of this deformity. In one, a knuckle of intestine covered by skin projects from the navel. This degree of deformity is common, occurring in two per cent. of infants. It is treated by a convex button, cork, or hard-rubber compress on a strip of adhesive plaster, which

encircles two-thirds of the child's body. This improvised truss is renewed from time to time, and should be worn six months. In the second variety there is an exomphalic condition, due to defective development, the intestines protruding from the umbilicus covered only by amnion. An immediate plastic operation is indicated even if the mass of protruding intestines is as large as an apple. The results of this operation have been excellent.

Spina bifida is to be distinguished from the less serious conditions—fibroma, myxoma, or lipoma of buttocks—and from parasitic teratomata. In spina bifida a hardened patch is found at the prominence of the tumor, due to the attachment at that point of the cauda equina.

Treatment.—Lay the tumor open, dissect out the sac, make traction upon the latter, when the cauda equina will retreat into the canal; ligate with catgut the pedicle formed, and accurately close up the wound with buried catgut sutures, with strict asepsis. The prognosis is not good. If the child survives the operation, it is not unlikely to die of hydrocephalus.

Imperforate Rectum.—The anus and rectum should be examined immediately after birth in all cases. To avoid the danger of fecal accumulation, inguinal or lumbar colotomy may be necessary. In simple cases with merely a transverse septum between the anus and the rectum, a cruciform incision over the imperforate anus is sufficient to open the rectum. The mucous membrane of the bowel is then stitched to the skin of the anus. An attempt should always first be made to reach the rectum from the perineum. I have succeeded in one case in which it was necessary to make a blunt dissection two inches up into the infant's pelvis. Should this attempt fail, colotomy is necessary.

Technic of Inguinal Colotomy for Atresia Ani.—Make an incision above and parallel with Poupart's ligament on the left side; deliver the distended sigmoid flexure; put two stitches through it, one on each side of the bowel, the threads running parallel with one another and with the long axis of the bowel, the two ends of each stitch entering and emerging from the bowel-wall about a quarter of an inch apart; incise the bowel between the two stitches, pulling it well down below the abdominal wound, to guard the peritoneal cavity from contamination, as meconium and gas make their escape. Making the wound in the bowel gape by pulling upon the ligatures through its wall, a few interrupted sutures are passed through the bowel at the site of the opening and the abdominal wall, fastening the two together. Finally, the edges of the abdominal and bowel wound are whipped together with a continuous catgut stitch, to prevent hemorrhage from the former. An anesthetic is not absolutely necessary. I have seen the infant nursing contentedly from its

mother's breast five minutes after such an operation. Later, the rectum may be probed from above to determine the depth of the incision necessary to reach it from the anus.

Nasal Catarrh (Snuffles).—*Causes.*—When the disease is not syphilitic, it is due, usually, to faulty clothing or to drafts of air. The crib should be protected, and the child should wear a thin lawn cap until its head is covered by a growth of hair.

Diseases of the Mouth.—**Aphthæ** are rounded, pearl-colored vesicles seen in the mouth and on the lips. Washing the mouth daily with a clean linen towel will prevent them. Boric acid, gr. v–x to the ounce, as a wash, is curative.

In true **thrush** there is a coalescence of white spots, with an areola of reddened mucous membrane. The disease is often seen in hospital practice, or in infants whose hygienic surroundings are bad. It is due to the presence of a parasite, the saccharomyces albicans.

Treatment.—Boric acid, gr. xvj–xx to ʒj of honey. One-half of a dram of this mixture is put in the mouth three or four times a day. The associated symptoms of malnutrition, diarrhea, and vomiting indicate attention to hygienic surroundings, to the general health of the child, and to its diet.

In **gonorrheal stomatitis** there is violent inflammation of the oral mucous membrane, due to the presence of gonococci. Cleanliness and mild disinfection of the mouth with boric acid solution will effect a cure. The disease is rare. I have seen but one case in all my hospital services.

Sublingual cysts are probably the result of the occlusion of the duct of a submaxillary gland. The cyst appears in the first few days after birth, and may reach such a size as to displace the tongue and to interfere with sucking. The treatment consists of puncture of the cyst, which does not return.

Colic, Diarrhea, Constipation.—**Colic** always indicates a careful attention to diet. Medicinally, gr. j of pepsin may be given in ʒj of hot water, with a few drops of brandy or gin. Milk of asafetida, gtt. xx–xl, or soda-mint, ʒj, may be used, and a spice-plaster may be applied to the abdomen.

Diarrhea indicates almost always some error in the diet. Frequent serous movements, draining the child's strength and demanding a remedy, may be checked with the following:

℞. Acid. sulphuric. aromat.,
Tinct. opii camph., ... āā gtt. iv.
One dose, not to be repeated.

Constipation.—In simple cases a dose of castor oil (ʒj), the soap-stick, a glycerin suppository or injection (gtt. xv–xx in fʒj of water) suffice, or the following may be used:

℞. Calcined magnesia,
Sugar of milk, ... of each 7½ grains.

For chronic constipation the daily injection of warm soap-suds (f℥ij) by a soft-bulb rubber ear-syringe is least harmful.

Medicinally, the treatment may consist of a piece of flake manna in each bottle of artificially fed children; the administration of ten drops of the syrup of figs, with two to four drops of the fluid extract of cascara; a pinch of salt in the bottles; the addition of Mellin's food, and daily abdominal massage; the addition to each bottle of milk of two to four grains phosphate of soda; an increase in the proportion of cream; Tarrant's Seltzer Aperient (ten grs.) in the milk; a little milk of magnesia, added to one or more bottles or given in water to a nursing baby.

Intussusception.—In a case in the University Maternity, the child died forty-eight hours after birth. The symptoms began in the first twenty-four hours; the child passed blood and mucus by the bowel, developed high fever, and vomited incessantly. Postmortem examination showed the intussusception in the ileum; the bowel above was much distended; below, inflamed and very dark in color for a couple of inches.

Skin Diseases.—**Gum,** a sort of acne, is due to the irritation of the skin by the atmosphere and the clothing. It is exceedingly common.

Treatment.—Cleanliness, proper clothing, and some simple ointment, perhaps as a salve to the mother's anxiety as much as to the infant's skin.

Furuncles are likely to be small and numerous. The condition is an exaggeration of gum, with enlargement and suppuration of the pimples.

The diet and hygienic surroundings should be investigated. The small boils may be washed twice daily with a solution of boric acid, gr. xv, and resorcin, gr. iij–f ℥j, and boric acid ointment, ℥j–℥j, ung. aq. rosæ, may be applied. The boils may be opened with a needle when they come to a head.

Simple acute pemphigus is very rare. From the second day to the fourth, fifth, or sixth week, vesicles the size of a pea to a quarter- or half-dollar appear indifferently over the whole body, except the soles of the feet and the palms of the hands. The disease lasts from twelve to fourteen days, without manifestation of constitutional disturbance.

It is contagious, and may be carried by the nurse or be communicated to a mother or nurse. It disappears without treatment. A specific micro-organism, it is claimed, has been discovered, but the staphylococcus pyogenes aureus is generally regarded as the infecting agent.

Syphilitic pemphigus usually begins *in utero*, and the child is born with the vesicles upon it, the soles of the feet and the palms of the hands being most often affected. The disease is associated with marked evidence of malnutrition and constitutional disturbance, and yields only to specific treatment.

Ophthalmia Neonatorum.—*Symptoms.*—True ophthalmia is the result of the infection of the conjunctivæ by gonococci. Usually after twenty-four to forty-eight hours the eyelids are edematous and puffed out, and between them there appears a seropurulent discharge, which soon becomes greenish-yellow pus, and in which gonococci are found under the microscope. When the lids are separated, the conjunctivæ are seen to be red and velvet-like in appearance, and later the cornea may lose its epithelium, become glazed, ulcerate, and be perforated.

Treatment, Prophylactic.—As soon as the head is born, the orbital region is wiped clean with soft linen squares, soaked in a boracic acid solution. When the delivery is completed, the eyes are again cleansed by injecting into the conjunctival sacs boracic acid solution (gr. x to aq. destil. f℥j) by an eye-dropper. In hospital practice uniformly, in private practice if there is reason to suspect a gonorrheal infection of the mother's vagina, several drops of a 25 per cent. solution of argyrol are instilled in the eyes.[1]

Curative.—The eyes are cleansed every hour, day and night, with a concentrated solution of boric acid. Cold compresses are kept upon the lids. Morning and evening argyrol solution, 25 per cent., is instilled. If only one eye is affected, the other should be carefully bandaged with a pledget of lint to protect it. A drop of a weak solution of atropia is occasionally required. If possible, the case should be placed under the care of an oculist. The author invariably refuses to accept the responsibility of treating such a case. The mouth, the nose, and the ears of a new-born infant may be the seat of gonorrheal inflammation.

There is frequently a **subacute conjunctivitis** after birth, often affecting one eye alone, and yielding to the mildest treatment, or disappearing spontaneously. The inexperienced physician not infrequently mistakes this innocuous inflammation for ophthalmia, and by the injudicious energy of his treatment converts a mild into a very severe conjunctivitis. I have seen permanent opacity of the corneæ from the unnecessary use of nitrate of silver in such a case. The severest possible inflammation, ending in total blindness, has resulted from the injection of sublimate solution in the vagina during labor, the corrosive sublimate gaining access to the child's eyes and causing inflammation and perforation of the corneæ.

[1] See Christian, "Medical Record," vol. lxii, 1902.

Hemophilia is an inherited pathological disposition to bleed from apparently normal or slightly injured surfaces. The manner of transmission is peculiar; it is always through the mother to male children, who do not transmit it. The female children are said to show no evidence of the disease, but transmit it. The cause is not known, and it manifests itself throughout life. Treatment is of no avail. It should be remembered that a hemorrhagic diathesis is sometimes due to syphilis, and in such cases specific treatment is of value. I have seen a hemophilic infant bleed to death from its conjunctivæ, incessantly weeping tears of blood, and another lose its life from hemorrhage following a superficial abrasion under the tongue. Dr. M. D. Hoyt gives me the notes of a female infant which bled to death from its wrists, ankles (hemidrosis), cord, nose, and lungs. The hemorrhage continued four days.

Icterus.—There are two classes of cases:

In the first the jaundice is slight in degree. The face and breast only are affected. This grade of jaundice is very common, the majority of children manifesting it.

The *cause* is said to be hepatogenic. The very small common biliary duct fails to empty into the bowel the excess of bile produced by the liver. The discoloration disappears a few days after birth, and the condition usually requires no treatment. Fractional doses of calomel may be given if the child's digestion is impaired, or if the jaundice is deeper than common.

In the second variety the whole body is jaundiced. The urine and feces are discolored, and may contain blood. This variety is decidedly rare, and is a manifestation of grave systemic derangement, usually general septic infection.

Causes.—This kind of jaundice is said also to be, as a rule, hepatogenic. It is seen in Buhl's and Winckel's disease, in atresia of the bile-duct, and in polycystic disease of the liver. In streptococcic infection of the blood-current producing disintegration of the blood, the jaundice, I believe, is in part hematogenic, resulting from a disintegration of the blood-corpuscles.

The prognosis of the malignant variety is extremely grave. The result is almost invariably fatal.

Cyanosis was once thought to be synonymous with congenital heart disease. The laity still regard a "blue baby" as one with a defective heart.

The *causes* of cyanosis, in the order of their frequency, are: pneumonia (often syphilitic), premature birth, asphyxia, atelectasis, degeneration of the blood, malformation of the heart and blood-vessels, interference with the function of the nerves of respiration, malformation of the respiratory tract, congenital pleurisy, and partial occlusion of the trachea.

Congenital heart affections may result from intra-uterine endocarditis, as stenosis of the right and left auriculoventricular orifices, stenosis of the aortic and pulmonary orifices, and insufficiency of the valves. Or they may be the result of defective development, as patency of the foramen ovale, atresia of the pulmonary artery, stenosis of the conus arteriosus, and defects in the ventricular septum.

A child with congenital heart disease must be managed with extraordinary care. Exposure to cold is particularly dangerous, as there is a tendency to pulmonary congestion and pneumonia. Artificial heat may be necessary; malnutrition must be combated; heart tonics may be required. The prognosis is relatively favorable. Compensation may often be secured in apparently the most unfavorable cases.

Diseases of Umbilicus.—Septic Infection.—The ulcer on an infected umbilicus is covered with a grayish, diphtheritic membrane, has a reddened areola, and the local inflammation leads to general infection. An acute, high fever in a new-born infant suggests septic infection or pneumonia. The latter may be septic. The so-called Buhl's and Winckel's diseases, with fatty degeneration of the organs, icterus, cyanosis, and hemoglobinuria, are merely the result of streptococcic infection of the blood-current.

Treatment, Prophylactic.—The ulcer should be exposed at the daily bath, cleansed with soap and water, and dressed with salicylic acid, 1 part; starch, 5 parts. An aseptic ligature should always be used to ligate the cord at birth, and the daily dressing of the cord with fresh salicylated cotton should be carefully carried out with clean hands until the cord drops off.

Curative Treatment.—The ulcer should be touched with a solution of bichlorid of mercury, 1 : 500, or with nitrate of silver solution, ʒj–fʒj. It should be thoroughly irrigated and dusted with salicylic acid and starch, and covered with salicylated cotton.

Umbilical fungus is usually an overgrowth of granulation tissue. It projects in a mass like a strawberry from the navel. It should be cauterized with a solid stick of nitrate of silver, whereupon it promptly melts away. In about one-fifth of the cases cauterization fails, the tumor is more solid in feel, and is found, on microscopic investigation, to be the remains of the omphalic duct. This kind of umbilical fungus is called an entero-teratoma. It should be ligated and cut off. The stump of the cord may persist, unchanged, almost indefinitely, covered with an angry, red layer of granulation cells, or a spur of well-organized connective tissue may project from the umbilicus. In such cases

there is a small supply of blood to the cord in spite of the ligature. The projecting mass must be cut off. I have been obliged to amputate the persistent stump of a cord on the sixteenth day.

Omphalitis is a peculiar inflammation of the umbilicus and surrounding structures, in which the abdomen becomes conical in shape; the skin and subcutaneous connective tissue are hard, red, and infiltrated. It is always septic in origin. It requires disinfection of the umbilicus, poultices, and early incisions, with stimulants and supporting treatment. A later stage of the inflammation is gangrene. The prognosis is very grave. It is difficult to avert general systemic infection.

Inflammation of the umbilical vessels is always due to septic infection, and invariably leads to systemic infection, which is commonly fatal.

Hemorrhage from the Umbilicus (Omphalorrhagia).—The bleeding may come from the cord or from the umbilical ulcer. It may be primary, from careless ligation of the cord; or secondary, after the cord drops off. The vessels of the cord close from the placental end inward, and the hypogastric arteries may be patulous after the cord drops off, when increased blood-pressure or handling the ulcer may bring on hemorrhage. The mortality of this accident is computed at seventy-six to eighty-three per cent.

Treatment.—In primary hemorrhage the cord must be promptly re-ligated. In bleeding from the umbilical stump, if the bleeding vessels are seen, they should be ligated. Usually, it is impossible to isolate the bleeding vessels. In such cases the hemorrhage may be controlled by Monsel's solution and pressure by liquid plaster-of-Paris poured into the navel, where it "sets," by powdered suprarenal extract, or by successive layers of powdered bismuth, with gauze and collodion. Ergotin hypodermatically (gr. ss), gallic acid (gr. j) by the mouth, and gelatin (5 c.c. of a 10 per cent. solution in sterile normal salt solution) hypodermatically should be employed in addition to the local treatment. As a last resort, the abdominal wall around the navel should be transfixed with harelip pins or ordinary large-sized needles, and a figure-of-eight ligature should be applied under them. If there is sufficient stump of the cord left, it should be drawn out and transfixed with two pins or needles and ligated below them. I was able to check a hemorrhage in this way several days after the cord had dropped off. If this is impossible, one pin and a ligature may suffice; it should transfix the abdominal wall just below the umbilicus, so as to occlude the hypogastric arteries. Before inserting the pin the abdominal walls should be compressed and rolled between the thumb and

forefinger to get rid of coils of intestines. Should the hemorrhage continue, it can be controlled by a pin and a ligature above the umbilicus to occlude the umbilical vein.

Tetanus of the new-born is the result of the entrance of tetanus bacilli through the umbilicus. The disease in temperate climates occurs almost exclusively in hospitals. It is usually fatal, the death-rate being over ninety per cent. The treatment

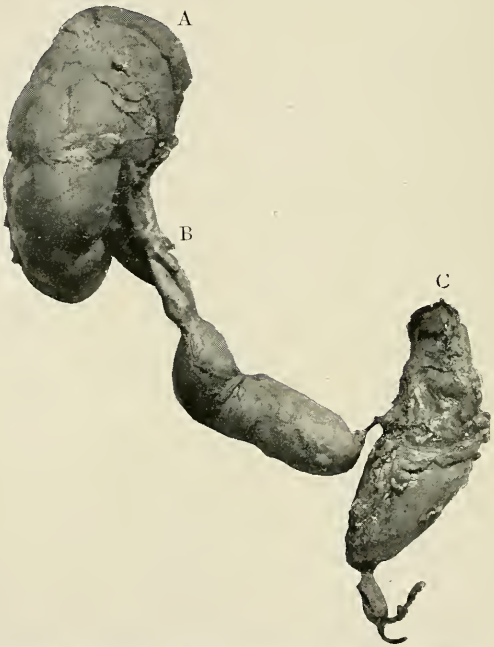

Fig. 776.—Atresia of the ureter: A, Kidney; B, ureter; C, bladder (author's case in University Maternity).

should always include an immediate and a thorough disinfection of the navel.

Melena, or gastro-intestinal hemorrhage, is an extravasation of blood into the stomach and intestines, occurring most often in the first few hours of life. Duodenal ulcer, some congenital defect increasing intra-abdominal blood-pressure, intussusception, or hemophilia may be the cause. The child may vomit bright, unaltered blood, or the vomit may be "coffee-grounds" in character. The blood from the bowel is black in color, and is mixed with meconium, hence the name melena. It is to be carefully distinguished from the vomiting of blood derived from a fissured

nipple in the mother and ingested with the milk. In melena the infant shows unmistakable symptoms of internal hemorrhage.

Treatment.—Gallic acid, gr. ij, may be given every hour, Ergotin hypodermatically, an ice-bag to the abdomen, and hot bottles to the flanks and thighs. Stimulation may be required. The mortality, in spite of intelligent and energetic treatment, is fifty per cent.

Bloody discharge from the genitalia of female children is not very rare. It shows an activity of the sexual organs analogous to the breast changes in the new-born. The condition is not dangerous, and requires no treatment. The blood comes from the uterus, like the menstrual discharges—in fact, the discharge is a true menstruation, as has been demonstrated in postmortem examinations of infants who died from intercurrent affections. It appears three or four days after birth, and lasts only a few days.

Sudden death of apparently healthy children is an accident not infrequently demanding an explanation by the attending physician.

Among the *causes* may be found *overlying by the mother*, accidentally or intentionally. In one of the reports of the Registrar-general of England, there was a record of 1500 cases, the majority occurring on Saturday night!

Diseases.—Most commonly pneumonias, apoplexies, more rarely perforation or intussusception of the bowels, rupture of a large viscus, or any of the diseases previously described, which had not been detected during life.

Occlusion of the trachea by an enlarged thymus or by curds of milk.

Congenital deformities of important internal organs, as atresia of the ureter.

Medication of the New-born.—In administering medicine to a newly born infant, the physician should remember its peculiar *intolerance of opium* and its tolerance of some other remedies.

The following are some of the drugs and their doses required in the first four weeks of life: Opium, only as paregoric, from two to five drops in one dose, *not repeated;* mercury, always as calomel, $\frac{1}{12}$ to $\frac{1}{8}$ gr.; castor oil, 15 gtt. to ʒj; nitrate of silver, $\frac{1}{60}$ to $\frac{1}{40}$ gr.; pepsin, gr. j–ij; gallic acid, gr. ss–ij, etc.

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